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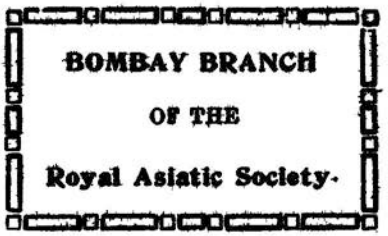

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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY—VOL. VIII.

REPORT

ON THE

SCIENTIFIC RESULTS

OF THE

VOYAGE OF H.M.S. CHALLENGER

DURING THE YEARS 1873-76

UNDER THE COMMAND OF

CAPTAIN GEORGE S. NARES, R.N., F.R.S.

AND

CAPTAIN FRANK TOURLE THOMSON, R.N.

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ac.

PREPARED UNDER THE SUPERINTENDENCE OF

THE LATE

Sir C. WYVILLE THOMSON, Knt., F.R.S., &c.

REGIUS PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF EDINBURGH
DIRECTOR OF THE CIVILIAN SCIENTIFIC STAFF ON BOARD

AND NOW OF

JOHN MURRAY, F.R.S.E.

ONE OF THE NATURALISTS OF THE EXPEDITION

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ZOOLOGY—VOL. VIII.

CC.K.16

Published by Order of Her Majesty's Government

PRINTED FOR HER MAJESTY'S STATIONERY OFFICE

AND SOLD BY

LONDON:—LONGMANS & CO.; JOHN MURRAY; MACMILLAN & CO.; SIMPKIN, MARSHALL & CO.
TRÜBNER & CO.; E. STANFORD; J. D. POTTER; AND KEGAN PAUL, TRENCH, & CO.
EDINBURGH:—ADAM & CHARLES BLACK AND DOUGLAS & FOULIS.
DUBLIN:—A. THOM & CO. AND HODGES, FIGGIS, & CO.

1883

Price Forty Shillings.

505.306
Hor/Rep/Zoo
142591

PRINTED BY NEILL AND COMPANY, EDINBURGH,
FOR HER MAJESTY'S STATIONERY OFFICE.

00142591

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By George Stewardson Brady, M.D., F.R.S, F.L.S.

(*Received August* 1, 1883.)

II.—Report on the Calcarea dredged by H.M.S. Challenger, during the years 1873–1876.

By N. Poléjaeff, M.A. of the University of Odessa.

(*Received September* 10, 1883.)

III.—Report on the Cirripedia collected by H.M.S. Challenger, during the years 1873–1876.—Systematic Part.

By Dr. P. P. C. Hoek, Member of the Royal Academy of Science of the Netherlands.

(*Received August* 31, 1883.)

EDITORIAL NOTES.

THIS volume contains Parts XXIII., XXIV., and XXV. of the Zoological Series of Reports on the Scientific Results of the Expedition.

Part XXIII.—The Report on the COPEPODA is the Second Report on the ENTOMOSTRACA collected during the Expedition, from the pen of Dr. George Stewardson Brady, F.R.S. It will be remembered that his Report on the OSTRACODA was published in 1880, and forms Part III. of the Zoological Series.

Part XXIV.—The Report on the CALCAREA is by Dr. N. Poléjaeff, of the University of Odessa, and a distinguished pupil of Professor Franz Eilhard Schulze. Dr. Poléjaeff has also undertaken the Report on the CERAOSPONGIÆ, and it is expected that this Second Memoir will be ready for publication in a few months, as the investigation is already in a forward state.

The other gentlemen engaged in the preparation of Reports on the PORIFERA are Professor F. E. Schulze—the HEXACTINELLIDA; Professor W. J. Sollas—the TETRACTINELLIDA; and Mr. S. O. Ridley—the MONACTINELLIDA.

Part XXV. forms the first instalment of Dr. P. P. C. Hoek's Report on the CIRRIPEDIA collected during the Expedition. A Supplementary Memoir, dealing with the Anatomy of the Group, will be published in the course of a few months.

Part XXII.—The Report on the FORAMINIFERA, by H. B. Brady, Esq., F.R.S.—is now nearly printed off, and will be issued shortly as Volume IX. Zoology.

JOHN MURRAY.

CHALLENGER OFFICE, 32 QUEEN STREET,
EDINBURGH, 28*th December* 1883.

ERRATUM.

In the Report on the Copepoda, page 111, line 22, delete (Fig. 1, *a*).

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the COPEPODA collected by H.M.S. Challenger during the years 1873-76. By GEORGE STEWARDSON BRADY, M.D., F.R.S., F.L.S.

THE Copepoda noticed in this Report were taken almost entirely from surface-net gatherings made during the cruise; some few collections were made in the tow-net, at various depths below the surface, and a still smaller number by the "tow-net at trawl"; and lastly, a few specimens were found entangled on the swabs of the dredge. But where nothing of this kind is specified, it may be taken for granted that the captures were made at the surface. The material so obtained was mostly preserved in rectified spirit, a method which hardens the animals, rendering them opaque, destroying, usually, every trace of the natural colour, and obscuring almost entirely the internal anatomy.[1] In addition to these spirit-specimens, there was a comparatively small series mounted for the microscope in Canada balsam or glycerine, and from some of these details of structure were got which were unattainable in other cases.

The entire series of tow-net gatherings brought home from the different areas worked over by the Challenger was carefully examined. A list of the most important of these, with the names of the Copepoda found in each, is given hereafter (p. 7 *et seq.*). In many cases no Copepoda at all were found.[2] This, however, cannot be considered a point of any importance, for there can be no manner of doubt that the sea, from the equator to the

[1] A really good preservative solution—one not only protecting from mould and decay, but also preserving the natural transparency and colours of the tissues, while giving them a serviceable firmness—is yet to be discovered. Alcohol, in other respects perfect, has the great disadvantage of destroying both colour and transparency, and glycerine, though almost free from these defects, is a most unpleasant medium, on account of its density and stickiness. On the whole, a saturated solution of boracic acid in glycerine, diluted with three or four parts of water, has given in my hands the best results; but my preparations so made have not yet had sufficient time for fair trial.

[2] This statement refers to the preserved specimens sent to Dr. Brady. As a matter of fact, Copepoda were rarely, if ever, absent from the tow-net gatherings when examined on board ship.—J. M.

poles, supports everywhere a profusion of Entomostracan life, chiefly of the order Copepoda. But the appearance of these minute creatures at the surface depends upon conditions, the nature of which we scarcely at all understand. Night, on the whole, seems to be more favourable than daytime;[1] but even during the day they sometimes appear in numbers so vast as to colour the sea in wide bands for distances of many miles. This appearance has been noticed, perhaps, most frequently in the tropics; but even in the Arctic seas some species, especially *Calanus* (*Cetochilus*) *finmarchicus*, are at times so abundant as to constitute, it is said, a most important item in the food of the whale. So far, indeed, as number and size of individuals are concerned, it would appear that the cold water of the Arctic and Antarctic seas are even more favourable to the growth of Copepoda than the warmer areas of the tropics. In the cold polar seas *Calanus finmarchicus*, and perhaps other nearly allied forms, are the most characteristic members of the surface-fauna; while, if we may judge by the results of the Challenger Expedition, the warm equatorial and sub-tropical areas present a much greater variety of Copepoda, but no one species in very preponderating abundance. If we might venture to assign to the tropical and warmer temperate seas, one or more species holding the same position there as *Calanus finmarchicus* in the cold zones, we should name *Undina darwinii* and *Euchæta prestandreæ;* but there are several other species which would follow close upon the heels of these two.

As in the case of many other purely pelagic or aquatic animals, the range of distribution of many of the marine Copepoda is extremely wide[2]: to find a free-swimming species ranging over a very small district is a rare exception, and the probability is that where this appears to be the case, further research will usually reveal its presence throughout a larger area.

The seven geographical areas adopted in the Table of Distribution are identical with those used in the Report on the Ostracoda.[3] Of the ninety free-swimming species

[1] Take, for example, the lists of two surface-net gatherings from Port Jackson (pp. 10, 11), one taken by day, containing ten species, the other by night, fifteen species. This, by itself, is not of much account, but my friend Mr. David Robertson and myself have found, in a pretty large experience of surface-net work in the British Seas, that several kinds of Entomostraca—Ostracoda as well as Copepoda—are got commonly at night, but rarely, if at all, during the day.

[2] An interesting example of the very wide distribution of pelagic, as opposed to terrestrial or abyssal animals, was noticed in the report on the Ostracoda—the only species found in all the seven areas being two natatory animals—*Halocypris atlantica* and *Halocypris brevirostris*.

[3] The Stations are divided amongst the seven areas as follows:—

1. North Atlantic Ocean (Stations 1 to 110 and 348 to 354).
2. South Atlantic Ocean (Stations 111 to 142 and 313 to 347).
3. South Indian Ocean or Southern Ocean, extending to the Antarctic Circle (Stations 143 to 160).
4. Australasia, including the Coasts of Australia, New Zealand, and the Eastern Archipelago south of the equator (Stations 161 to 196 and 217 to 220).
5. South Pacific Ocean (Stations 271 to 312).
6. North Pacific Ocean (Stations 238 to 270).
7. Eastern Asia, including China, Japan, and the Eastern Archipelago north of the equator (Stations 197 to 216 and 221 to 237).

here tabulated, only one (*Euchæta prestandreæ*) was found in all the seven districts, but no fewer than nine species occurred in all but one of the areas; these being *Calanus propinquus, Eucalanus attenuatus, Scolecithrix danæ, Pleuromma abdominale, Undina darwinii, Centropages violaceus, Candace truncata, Corycæus varius,* and *Oncæa obtusa. Undina darwinii, Scolecithrix danæ, Centropages violaceus, Corycæus varius,* and *Oncæa obtusa* were not found in the Southern Indian Ocean; but this area was not investigated north of latitude 43° S., and it is more than likely that the tropical zone of that ocean would have produced these species abundantly. *Pleuromma abdominale* was wanting in the gatherings from Eastern Asia, and *Candace truncata* from the South Pacific. All nine species usually occur in considerable abundance, excepting, perhaps, *Centropages violaceus,* which is certainly much scarcer than the rest. The area producing the smallest number of species (fifteen), is the South Indian Ocean, doubtless for the reason already stated; from the North Pacific the number is not much greater, twenty-two. Leaving out of consideration the fish-parasites, the largest numbers of species were obtained from the North Atlantic, South Atlantic, Eastern Asiatic, and Australasian seas, the numbers from each of these areas being forty-eight, forty-eight, forty-five, and forty-two respectively. The only undoubted deep-sea species is *Pontostratiotes abyssicola,* the single specimen of which—dredged in a depth of 2200 fathoms—was picked from the dried mud, having unfortunately lost much character in the drying process. Some others were got in deep hauls of the tow-net, but these were usually either well-known species, or so much battered as to make recognition impossible, and it is very likely that most of them were captured during the passage of the net towards the surface. *Calanus princeps* may, however, be noted as an exception to this statement, the two or three specimens from which our knowledge of the species is derived, having come up with deep hauls of the dredge, and most probably from the very depths of the sea. Possibly we might also include amongst abyssal species *Hemicalanus aculeatus, Phyllopus bidentatus,* and one or two *Euchætæ* (see lists, pp. 19 and 22), but it is not by any means certain that these specimens came from the bottom.

The fish-parasites are remarkably few, considering the attention which was paid to ichthyology, and the considerable number of fishes captured during the expedition. All the species that have come under my observation are noted in these pages.

Geographical Distribution of the Copepoda collected during the Cruise of H.M.S. Challenger.

Calanidæ	1 North Atlantic.	2 South Atlantic.	3 South Indian Ocean.	4 Australasia.	5 South Pacific.	6 North Pacific.	7 Eastern Asia.
Calanus finmarchicus (Günner),				+	+		
propinquus, n. sp.,	+	+	+	+	+	+	
valgus, n. sp.,	+	+		+	+		
tonsus, n. sp.,		+		+	+		
gracilis, Dana,	+	+		+	+		+
princeps, n. sp.,	+						
Eucalanus attenuatus, Dana,	+		+	+	+	+	+
setiger, n. sp.,	+			+			+
Rhincalanus cornutus, Dana,	+						+
gigas, n. sp.,		+	+			+	+
Hemicalanus longicornis, Claus,	+	+			+		
orientalis, n. sp.,				+			
aculeatus, n. sp.,			+			+	
Pleuromma abdominale (Lubbock),	+	+	+	+	+	+	
Heterochæta spinifrons, Claus,	+	+	+		+		
Leuckartia flavicornis, Claus,	+	+	+	+	+		
scopularis, n. sp.,						+	
Undina vulgaris Dana,	+	+		+		+	+
darwinii, Lubbock,	+	+		+	+	+	+
Scolecithrix danæ (Lubbock),	+	+		+	+	+	+
minor, n. sp.,			+				
Euchæta prestandreæ, Philippi,	+	+	+	+	+	+	+
hessei, n. sp.,	+			+	+	+	+
pulchra (Lubbock),	+						
philippii, n. sp.		+			+		
australis, n. sp.,		+		+			
gigas, n. sp.,		+					
barbata, n. sp.,		+					
Calanoides patagoniensis, n. gen. and sp.,					+		
Ætidius armatus, n. gen. and sp.,	+	+	+	+			+
Drepanopus pectinatus, n. gen. and sp.,			+				
furcatus, n. gen. and sp.,	+			+	+		
Phyllopus bidentatus, n. gen. and sp.,		+					
Temora dubia (Lubbock),	+	+		+	+		+
armata, Claus,	+						
Centropages brachiatus (Dana),					+		
furcatus (Dana),				+			+
violaceus (Claus),	+	+		+	+	+	+
Candace pectinata, Brady,	+			+			+
pachydactyla, Dana,	+	+		+	+		+
truncata, Dana,	+	+	+	+		+	+

	1 North Atlantic.	2 South Atlantic.	3 South Indian Ocean.	4 Austral-asia.	5 South Pacific.	6 North Pacific.	7 Eastern Asia.
CALANIDÆ—*continued.*							
Acartia luxa, Dana,	+						+
denticornis, n. sp.,		+			+	+	+
Corynura gracilis, n. gen. and sp.,							+
barbata, n. gen. and sp.,							+
Calanopia elliptica, Dana,					+		+
Pontellopsis villosa, n. gen. and sp.,		+				+	
Pontella acuta (Dana),				+			+
strenua (Dana),	+						
detruncata (Dana),	+	+				+	
acutifrons (Dana),	+	+		+		+	+
plumata (Dana),				+	+	+	+
lavidentata, n. sp.,							+
invrmis, n. sp.,		+					
Pontella krüyeri, n. sp.,				+			+
elephas, n. sp.,							+
securifer, n. sp.,	+						
magna (Lubbock),		+					
CYCLOPIDÆ.							
Oithona challengerii, n. sp.,	+	+		+		+	+
spinirostris, (?) Claus,		+					+
HARPACTICIDÆ.							
Ectinosoma atlanticum, (B. & R.),	+						
Paralothalestris imbricata, n. gen. and sp.,			+				
Zaus spinatus, Goudsir,			+				
Miracia efferata, Dana,	+				+		
Machairopus idyoides, n. gen. and sp.,			+				
Pontostratiotes abyssicola, n. gen. and sp.,		+					
Goniopsyllus rostratus, n. gen. and sp.,		+					
Stella gracilis, Dana,	+	+		+		+	+
CORYCÆIDÆ.							
Corycæus varius, Dana,	+	+		+	+	+	+
speciosus, Dana,	+						
rostratus, Claus,	+	+			+		
limbatus, n. sp.,		+					+
venustus, Dana,	+			+			+
obtusus, Dana,							+
Oncæa obtusa (Dana),	+	+		+	+	+	+
Copilia mirabilis, Dana,	+	+		+	+		+

	1 North Atlantic.	2 South Atlantic.	3 South Indian Ocean.	4 Australasia.	5 South Pacific.	6 North Pacific.	7 Eastern Asia.
CORYCÆIDÆ—*continued.*							
Lubbockia squillimana, Claus,	+	+			+		+
Pachysoma punctatum, Claus,							+
SAPHIRINIDÆ.							
Saphirina ovalis, Dana,	+	+		+	+		+
reticulata, n. sp.,		+					
inæqualis, Dana,	+	+		+	+		+
serrata, n. sp.,	+.			+			
opalina, Dana,				+	+		+
opaca, Lubbock,	+	+					
splendens, Dana,				+	+		
Saphirina gemma, Dana,	+	+		+	+		+
metallina, Dana,	+	+		+	+		+
sinuicauda, n. sp.,							+
augusta, Dana,		+					
Saphirinella stylifera (Lubbock),	+	+		+			
CALIGIDÆ.							
Lepeophtheirus suhmi, n. sp.,	+						
Echthrogaleus affinis, Milne-Edwards,							
Pandarus cranchii, Leach,				+			
satyrus, Dana,							
zygœnæ, n. sp.,	+						
Perissopus dentatus, Steenstrup and Lütken,							
Alebion carchariæ, Kröyer,	+						
Nogagus grandis, Steenstrup and Lütken,							
lunatus, Steenstrup and Lütken,		+					
latreillii, Leach,				+			
curticaudis (Dana),				+			
validus, Dana,				+			
murrayi, n. sp.,		+					
DICHELESTIDÆ.							
Hessella cylindrica, nov. gen. and sp.,				+			
CHONDRACANTHIDÆ.							
Chondracanthus macrurus, n. sp.,				+			
LERNÆIDÆ.							
Lernæa hemiramphi, Kröyer?	+						

LIST OF THE PRINCIPAL LOCALITIES FROM WHICH COPEPODA WERE TAKEN, WITH THE NAMES OF THE SPECIES FOUND IN EACH.

Except where otherwise stated, all these gatherings were made during the daytime by means of the surface-net.

STATION 45.—May 3, 1873. Lat. 38° 34′ N., long. 72° 10′ W. Depth 1240 fathoms. Bottom temperature, 2°·4 C. Mud (dredge).

Calanus princeps, n. sp.

STATION 50.—May 21, 1873. Lat. 42° 8′ N., long 63° 39′ W. Depth 1250 fathoms. Bottom temperature, 2°·8 C. Grey ooze (dredge).

Calanus Princeps, n. sp.

May 22, 1873. Lat. 41° 19′ N., long. 63° 12′ W. South of Halifax, Nova Scotia.

Saphirina opaca, Lubbock.

STATION 99.—August 15, 1873. Lat. 7° 53′ N., long. 17° 26′ W.; also August 17, 1873.

Miracia efferata, Dana.

August 22–27, 1873. Mid-Atlantic, about 2° north of the Equator.

Calanus gracilis, Dana.
Eucalanus attenuatus, Dana.
Leuckartia ?
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Candace pachydactyla, Dana.
Corycæus speciosus, Dana.
Copilia mirabilis, Dana.
Saphirinella stylifera (Lubbock).

August 25, 1873. Lat. 1° 47′ N., long. 24° 26′ W. 40 fathoms.

Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.

October 5, 1873. Lat. 29° 1′ S., long. 28° 59′ W. Night.

Pontella acutifrons (Dana).
strenua (Dana).

STATION 132.—October 10, 1873. Lat 35° 25′ S., long. 23° 40′ W.

Saphirina reticulata, n. sp.
Saphirinella stylifera (Lubbock).

STATION 144.—December 24, 1873. Lat. 45° 57′ S., long. 34° 39′ E.

Ætidius armatus, nov. gen. and sp.
Rhincalanus gigas, n. sp.

STATION 146.—December 29, 1873. Lat. 46° 46′ S., long. 45° 31′ E.

Calanus propinquus, n. sp.
Eucalanus attenuatus, Dana.
Hemicalanus aculeatus, n. sp.
Heterochæta spinifrons, Claus.
Scolecithrix minor, n. gen. and sp.
Euchæta prestandreæ, Philippi.
Ætidius armatus, n. gen. and sp.
Candace truncata, Dana.

January 1, 1874. Lat. 46° 45′ S., long. 50° 42′ E. Off Crozets.

Drepanopus pectinatus, n. gen. and sp. (a large gathering, consisting almost entirely of this one species, all females).

STATION 149.—January 9, 1874. Lat. 49° 16′ S., long. 70° 12′ E. Betsy Cove, Kerguelen Island.

Drepanopus pectinatus, n. gen. and sp. (this gathering, like the preceding, contained only one species in great abundance).

January 23, 1874. Lat. 48° 42′ S., long. 70° 2′ W. Off Kerguelen Island.

Calanus propinquus, n. sp. (also a gathering consisting entirely of a single species).

January 25, 1874. Betsy Cove, Kerguelen Island.

Pseudothalestris imbricata, n. gen. and sp.
Zaus spinatus, Goodsir.
Machairopus idyoides, n. gen. and sp.

STATION 153.—February 14, 1874. Lat. 65° 42′ S., long. 79° 49′ E.

Rhincalanus gigas, n. sp.

February 14, 1874. Lat. 65° 42′ S., long. 79° 49′ E. Near the Ice Barrier, 100 fathoms.

Pleuromma abdominale (Lubbock).

February 16, 1874. Lat. 66° 29′ S., long. 78° W. Near the Ice Barrier.

Saphirinella stylifera (Lubbock).

STATION 154.—February 19, 1874. Lat. 64° 37′ S., long. 85° 49′ E.

Calanus propinquus, n. sp.
Rhincalanus gigas, n. sp.
Pleuromma abdominale (Lubbock).
Candace truncata, Dana.

(The first three species occur also in gatherings made on the 20th and 21st of February.)

STATION 158.—March 7, 1874. Lat. 50° 1′ S., long. 123° 4′ E.

Heterochæta spinifrons, Claus.
Ætidius armatus, n. gen. and sp.

STATION 159.—March 10, 1874. Lat 47° 25′ S., long. 130° 32′ E.

Calanus propinquus, n. sp.
Eucalanus attenuatus (Dana).
Rhincalanus gigas, n. sp.
Pleuromma abdominale (Lubbock).
Leuckartia flavicornis (?) Claus.
Euchæta prestandreæ, Philippi.

March 15, 1874. Lat. 39° 48′ S., long. 140° 40′ E. South of Australia.

Calanus propinquus, nov. sp.
Centropages violaceus (Claus).
Saphirina ovalis, Dana.

April 3, 1874. Lat. 38° 7′ S., long. 149° 18′ E. Off Cape Howe, Australia. In surface-net at night,

Calanus finmarchicus (Günner).
valgus, n. sp.
Pleuromma abdominale (Lubbock).

Undina vulgaris, Dana.
darwinii, Lubbock.
Drepanopus furcatus, n. gen. and sp.
Temora dubia (Lubbock).
Centropages violaceus (Claus).
Candace pectinata, Brady.
Oncæa obtusa (Dana).

April 1874 About lat. 39° 10′ S., long. 146° 37′ E. Bass Strait, off Mindanao.
Acartia denticornis, nov. sp.
Candace pectinata, Brady.
Setella gracilis, Dana.
Corycæus varius, Dana.
Oncæa obtusa (Dana).
Copilia mirabilis, Dana.
Saphirina ovalis, Dana.

June 8, 1874. Sydney Cove, Port Jackson, Australia. Daytime.
Undina vulgaris, Dana.
darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Temora dubia (Lubbock).
Centropages furcatus (Dana).
Candace pachydactyla, Dana.
Pontella acuta (Dana).
Corycæus varius, Dana.
Oncæa obtusa (Dana).
Saphirina splendens, Dana.

June 8, 1874. Sydney Cove, Port Jackson, Australia. At *night*.
Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
darwinii, Lubbock.
Leuckartia flavicornis, Claus.
Temora dubia (Lubbock).
Ætidius armatus, n. gen. and sp.
Candace pectinata, Brady.

Pontella acutifrons (Dana).
plumata (Dana).
Oithona challengerii, Brady.
Corycæus varius, Dana.
Oncæa obtusa (Dana).
Saphirina inæqualis, Dana.

STATION 164.—June 12, 1874. Lat. 34° 8′ S., long. 152° 0′ E. Off Port Jackson.

Calanus tonsus, n. sp.
Ætidius armatus, n. gen. and sp.
Undina vulgaris, Dana.
Temora dubia (Lubbock).

STATION 164 B.—June 14, 1874. Lat. 34° 3′ S., long. 152° 20 ′E. Between Sydney and Wellington.

Calanus valgus, n. sp.
Eucalanus attenuatus (Dana).
setiger, n. sp.
Undina vulgaris, Dana.
darwinii, Lubbock.
Temora dubia (Lubbock).
Candace pectinata, Brady.
Euchæta prestandreæ, Philippi.
Corycæus varius, Dana.
venustus, Dana.
Oncæa obtusa (Dana).

STATION 165.—June, 17, 1874. Lat. 34° 50′ S., long. 155° 28′ E. Between Sydney and Wellington.

Undina darwinii, Lubbock.
Candace pachydactyla, Dana.
Corycæus varius, Dana.
Oncæa obtusa, Dana.

August 11, 12, 1874. About lat. 19° S., long. 177° 10′ E. Off Kandavu, Fiji.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Pleuromma abdominale (Lubbock).[1]

[1] This species constitutes the bulk of the gathering.

Undina vulgaris, Dana.
Heterochæta spinifrons, Claus.
Leuckartia flavicornis (?) Claus.
Scolecithrix danæ (Lubbock).
Temora dubia (Lubbock).
Euchæta prestandreæ, Philippi.
Candace pachydactyla, Dana.
truncata, Dana.
Calanopia elliptica, Dana.
Pontella plumata (Dana).
Corycæus varius, Dana.
Copilia mirabilis, Dana.
Oncæa obtusa, Dana.
Saphirina inæqualis, Dana.
opalina, Dana.
Saphirinella stylifera (Lubbock).

August 25, 26, 1874. About lat. 13° 30′ S., long. 150° E. Between Api, New Hebrides, and Cape York, Australia.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Pleuromma abdominale (Lubbock).
Undina darwinii, Lubbock.
vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Temora dubia (Lubbock).
Euchæta prestandreæ, Philippi.
hessei, n. sp.
australis, n. sp.
Cadnace truncata, Dana.
pectinata, Brady.
Pontella acutifrons (Dana).
plumata (Dana).
Corycæus varius, Dana.
venustus, Dana.
Copilia mirabilis, Dana.
Oncæa obtusa, Dana.
Saphirina ovalis, Dana.
inæqualis, Dana.

STATION 181.—August 25, 1874. Lat. 13° 50′ S., long. 151° 49′ E.

Eucalanus attenuatus (Dana).
Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Pontella acutifrons (Dana).
Setella gracilis, Dana.
Corycæus varius, Dana.
Copilia mirabilis, Dana.
Oncæa obtusa, Dana.
Saphirina serrata, n. sp.

September 2, 1874. Port Albany, Cape York, Australia.

Eucalanus attenuatus (Dana).
Hemicalanus orientalis, n. sp.
Undina vulgaris, Dana.
darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Acartia laxa, Dana.
Pontella plumata (Dana).
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.

September 13, 1874. Lat. 8° 18′ S., long. 135° 7′ E. Arafura Sea.

Calanus valgus, n. sp.
Eucalanus setiger, n. sp.
Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Centropages furcatus (Dana).
Pontella acuta (Dana).
kröyeri, n. sp.

STATION 198.—October 20, 1874. Lat. 2° 55′ N., long. 124° 53′ E.

Eucalanus attenuatus (Dana).
Euchæta prestandreæ, Philippi.

Candace truncata, Dana.
Oithona challengerii, n. sp.
Corycæus varius, Dana.
Oncæa obtusa, Dana.
Saphirina metallina, Dana.

STATION 200.—October 23, 1874. Lat. 6° 48′ N., long. 122° 25′ E. Net at 80 fathoms. Daytime.

Eucalanus attenuatus (Dana).
setiger, n. sp.
Rhincalanus cornutus, Dana.
Undina vulgaris, Dana.
darwinii, Lubbock.
Temora dubia (Lubbock).
Candace truncata, Dana.
Corynura gracilis, n. gen. and sp.
Calanopia elliptica, Dana.
Pontella acuta (Dana).
lævidentata, n. sp.
kröyeri, n. sp.
elephas, n. sp.
Corycæus varius, Dana.
Lubbockia squillimana, Claus.
Copilia mirabilis, Dana.
Saphirina inæqualis, Dana.

October 23, 1874. Lat. 6° 47′ N., long. 122° 28′ W.

Temora dubia (Lubbock).
Corycæus varius, Dana.
Copilia mirabilis, Dana.

October 25, 1874. Off Zamboanga, Philippine Islands.

Eucalanus setiger, n. sp.
Undina vulgaris, Dana.
Temora dubia (Lubbock).
Acartia denticornis, n. sp.
Corynura gracilis, n. gen. and sp.
Calanopia elliptica, Dana.

Pontella acuta (Dana).
kröyeri, n. sp.
elephas, n. sp.
Saphirina ovalis, Dana.

STATION 201.—October 26, 1874. Lat. 7° 3′ N., long. 121° 48′ E. Net at 88 fathoms.
Undina vulgaris, Dana.
darwinii, Lubbock.
Euchæta prestandreæ, Philippi.
Copilia mirabilis, Dana.
Saphirina ovalis, Dana.

November 12, 1874. Lat. 15° 8′ N., long. 119° 49′ E.
Eucalanus attenuatus (Dana).
Undina darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Candace truncata, Dana.

January 18–23, 1875. Zebu Harbour, Philippine Islands.
Eucalanus attenuatus (Dana).
Eucalanus setiger, n. sp.
Euchæta prestandreæ, Philippi.
Undina vulgaris, Dana.
Acartia laxa, Dana.
Corynura barbata, n. gen. and sp.
Temora dubia (Lubbock).
Calanopia elliptica, Dana.

January 29–February 3, 1875. Off Zamboanga, Philippine Islands.
Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Acartia laxa, Dana.
Corynura gracilis, n. gen. and sp.
Setella gracilis, Dana.
Copilia mirabilis, Dana.
Pachysoma punctatum, Claus.

Oithona spinirostris (?) Claus.
Corycæus varius, Dana.
limbatus, n. sp.
Oncæa obtusa, Dana.

STATION 206.—January 8, 1875. Lat. 17° 54′ N., long. 117° 14′ E.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Rhincalanus cornutus, Dana.
Undina darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Ætidius armatus, n. gen. and sp.
Candace truncata, Dana.
Oithona challengerii, n. sp.
Corycæus varius, Dana.
venustus, Dana.
Saphirina metallina, Dana.
opalina, Dana.

January 9, 1875. Lat. 16° 35′ N., long. 117° 47′ E.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
setiger, n. sp.
Rhincalanus cornutus, Dana.
gigas, n. sp.
Undina darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
hessei, n. sp.
Centropages violaceus (Claus).
Candace pectinata, Brady.
truncata, Dana.
Corycæus varius, Dana.
venustus, Dana.
Copilia mirabilis, Dana.
Oncæa obtusa (Dana).
Saphirina opalina, Dana.

February 1875. On the Equator, about long. 140° E. North of Papua.

Undina vulgaris, Dana.
darwinii, Lubbock.
Pontella plumata (Dana).
Setella gracilis, Dana.
Oncæa obtusa (Dana).
Copilia mirabilis, Dana.
Saphirina opalina, Dana.
ovalis, Dana.

February 5, 1875. Zamboanga, Philippine Islands.

Eucalanus setiger, n. sp.
Undina vulgaris, Dana.
Temora dubia (Lubbock).
Centropages furcatus (Dana).
Candace truncata, Dana.
Acartia laxa, Dana.
Corynura gracilis, n. gen. and sp.
Calanopia elliptica, Dana.
Pontella kröyeri, n. sp.
elephas, n. sp.
Corycæus varius, Dana.
venustus, Dana.
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.
sinuicauda, n. sp.

February 6, 1875. Lat. 6°40′ N., long. 122° 57′ E. Near Zamboanga.

Eucalanus attenuatus (Dana).
setiger, n. sp.
Undina vulgaris, Dana.
darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Candace pachydactyla, Dana.
Calanopia elliptica, Dana.
Corynura gracilis, n. gen. and sp.
Pontella acuta (Dana).
plumata (Dana).
acutifrons (Dana).

Setella gracilis, Dana.
Corycæus varius, Dana.
venustus, Dana.
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.
inæqualis, Dana.
sinuicauda, n. sp.

February 1875. About lat. 4° N., long. 130 E. West of Papua.

Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Leuckartia flavicornis (?) Claus.
Setella gracilis, Dana.
Oncæa obtusa (Dana).
Corycæus sp.

April 3, 1875. Lat. 24° 49′ N., long. 138° 34′ E.

Euchæta hessei, n. sp.
Pontella plumata (Dana).
detruncata (Dana).

Inland Sea, Japan.

Corycæus obtusus, Dana.

Station 237.—June 17, 1875. Lat. 34° 37′ N., long. 140° 32′ E.

Eucalanus setiger, n. sp.
Scolecithrix danæ (Lubbock).
Candace pectinata, Brady.
Euchæta prestandreæ, Philippi.
Oncæa obtusa (Dana).

Station 241.—June 23, 1875. Lat. 35° 41′ N., long. 157° 42′ E.

Calanus propinquus, n. sp.

July 1875. About lat. 35° N. Between Japan and Honolulu.

Rhincalanus gigas, n. sp.
Euchæta prestandreæ, Philippi.
hessei, n. sp.
Leuckartia scopularis, n. sp.

STATION 256.—July 21, 1875. Lat. 30° 22′ N., long. 154° 56′ W.

Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
darwinii, Lubbock.
Euchæta prestandreæ, Philippi.
Centropages violaceus (Claus).
Candace truncata, Dana.
Pontella acutifrons (Dana).
detruncata (Dana).
Pontellopsis villosa, n. gen. and sp.
Setella gracilis, Dana.
Corycæus varius, Dana.
Oncæa obtusa (Dana).

STATION 257.—July 23, 1875. Lat. 27° 33′ N., long. 154° 55′ W. "Deep haul."

Hemicalanus aculeatus, n. sp.

August 16, 1875. Hilo Harbour.

Acartia denticornis, n. sp.
Candace pachydactyla, Dana.
Scolecithrix danæ (Lubbock).
Pontella plumata (Dana).
Oithona challengeri, n. sp.
Lubbockia squillimana, Claus.
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.
metallina, Dana.

STATION 268.—August 30, 1875. Lat. 7° 35′ N., long. 140° 49′ W.

Eucalanus attenuatus (Dana).
Undina darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Oithona, sp.
Oncæa obtusa (Dana).

October 18, 1875. Lat. 36° 0′ S., long. 132° 22′ W.

Pleuromma abdominale (Lubbock).
Undina darwinii, Lubbock.
Centropages violaceus (Claus).
Corycæus varius, Dana.

Station 287.—October 19, 1875. Lat. 36° 32′ S., long. 132° 52′ W.

Calanus finmarchicus (Günner).
valgus, n. sp.
Pleuromma abdominale (Lubbock).
Undina darwinii, Lubbock.
Euchæta hessei, n. sp.
Corycæus varius, Dana.
Saphirina ovalis, Dana.

Station 288.—October 21, 1875. Lat. 40° 3′ S., long. 132° 58′ W.

Calanus propinquus n. sp.
valgus, n. sp.
Hemicalanus longicornis, Claus.
Pleuromma abdominale (Lubbock).
Heterochæta spinifrons, Claus.
Centropages violaceus (Claus).
Euchæta philippii, n. sp.
Leuckartia flavicornis (?) Claus.
Lubbockia squillimana, Claus.
Miracia efferata, Dana.

October 22, 1875. Lat. 40° 0′ S., long. 131° 36′ W.

Calanus tonsus, n. sp.
Pleuromma abdominale (Lubbock).

November 6, 1875. Lat. 37° 50′ S., long. 93° 54′ W.

Calanus valgus, n. sp.
Euchæta hessei, n. sp.

Station 296.—Nov. 9, 1875. Lat. 38° 6′ S., long. 88° 2′ W.

Calanus valgus, n. sp.
tonsus, n. sp.

December 5, 1875. Off Valparaiso.
Calanus propinquus, n. sp.
Undina darwinii, Lubbock.
Corycæus rostratus, Claus.
Oncæa obtusa, Dana.

December 8, 1875. Off Valparaiso.
Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Drepanopus furcatus, n. gen. and sp.

STATION 299.—December 14, 1875. Lat. 33° 31′ S., long. 74° 43′ W. Net at 20 fathoms.
Calanus valgus, n. sp.
Drepanopus furcatus, n. gen. and sp.
Saphirina gemma, Dana.
splendens, Dana.
inæqualis, Dana.

STATION 302.—December 28, 1875. Lat. 42° 43′ S., long. 82° 11′ W.
Calanus tonsus, n. sp.
Undina darwinii, Lubbock.
Centropages violaceus (Claus).
Euchæta prestandreæ, Philippi.
Oncæa obtusa (Dana).

STATION 303.—December 30, 1875. Lat. 45° 31′ S., long. 78° 9′ W.
Eucalanus attenuatus (Dana).

STATION 304.—December 31, 1875. Lat. 46° 53′ S., long. 75° 12′ W.
Pleuromma abdominale (Lubbock).
Calanoides patagoniensis, n. gen. and sp.
Centropages brachiatus (Dana).

January 1876. Straits of Magellan.
Pleuromma abdominale (Lubbock).
Acartia denticornis (?) n. sp.
Centropages brachiatus (Dana).

STATION 318.—Feb. 11, 1876. Lat. 42° 32′ S., long. 56° 29′ W. Net at 30 fathoms.

Goniopsyllus rostratus, n. gen. and sp.
Oithona challengeri, Dana.
Corycæus varius, Dana.

STATION 319.—February 12, 1876. Lat. 41° 54′ S., long 54° 48′ W.

Saphirina reticulata, n. sp.
opaca, Lubbock.
ovalis, Dana.
inæqualis, Dana.

STATION 320.—February 14, 1876. Lat. 37° 17′ S., long. 53° 52′ W.

Rhincalanus gigas, n. sp.
Calanus propinquus, n. sp.
Pleuromma abdominale (Lubbock).
Heterochæta spinifrons Claus.

STATION 324.—February 29, 1876. Lat. 36° 9′ S., long. 48° 22′ W.

Calanus tonsus, n. sp.
valgus, n. sp.
Acartia denticornis, n. sp.
Pontella detruncata (Dana).
Saphirina inæqualis, Dana.

STATION 325.—March 2, 1876. Lat. 36° 44′ S., long 46° 16′ W. Depth 2650 fathoms. Dredge.

Calanus tonsus, n. sp.
Rhincalanus gigas, n. sp.
Pleuromma abdominale (Lubbock).
Heterochæta spinifrons, Claus.
Leuckartia flavicornis, Claus.
Euchæta prestandræ, Philippi.
australis, n. sp.
philippii, n. sp.
gigas, n. sp.
barbata, n. sp.
Phyllopus bidentatus, n. gen. and sp.
Oncæa obtusa (Dana).

STATION 325.—March 2, 1876. Lat. 36° 44′ S., long. 46° 16′ W. Surface net.

Undina darwinii, Lubbock.
Setella gracilis, Dana.
Corycæus rostratus, Claus.
Oncæa obtusa (Dana).

STATION 326.—March 3, 1876. Lat. 37° 3′ S., long. 44° 17′ W.

Temora dubia (Lubbock).
Centropages violaceus (Claus).
Corycæus varius, Dana.
Saphirina inæqualis, Dana.

March 3–5, 1876. About lat. 37° 15′ S., long. 43° 0′ W.

Calanus valgus, n. sp.
Centropages violaceus (Claus).
Candace pachydactyla, Dana.
Pontellopsis villosa, n. sp.
Oncæa obtusa (Dana).

STATION 330.—March 8, 1876. Lat. 37° 45′ S., long. 33° 0′ W.

Pleuromma abdominale (Lubbock).
Heterochæta spinifrons, Claus.

STATION 332.—March 10, 1876. Lat. 37° 29′ S., long. 27° 31′ W. Depth 2200 fathoms. Tow-net at trawl.

Pontostratiotes abyssicola, n. gen. and sp.
One specimen only taken.

STATION 335.—March 16, 1876. Lat. 32° 24′ S., long. 13° 5′ W

Scolecithrix danæ (Lubbock).
Ætidius armatus, n. gen. and sp.
Acartia denticornis, n. sp.
Oithona challengeri, n. sp.
Corycæus varius, Dana.
Saphirina ovalis, Dana.
angusta, Dana.

STATION 341.—March 25, 1876. Lat. 12° 16′ S., long. 13° 44′ W.

Euchæta prestandreæ, Philippi.
Oithona challengeri, n. sp.
spinirostris (?), Claus.
Corycæus varius, Dana.
limbatus, n. sp.
Lubbockia squillimana, Claus.

STATION 342.—March 26, 1876. Lat. 9° 43′ S., long. 13° 51′ W.

Calanus propinquus, n. sp.
gracilis, Dana.
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Centropages violaceus (Claus).
Candace truncata, Dana.
Oithona challengeri, n. sp.
Setella gracilis, Dana.
Corycæus varius, Dana.
rostratus, Claus.
Copilia mirabilis, Dana.
Lubbockia squillimana, Claus.
Oncæa obtusa, Dana.

STATION 348.—April 9, 1876. Lat. 3° 10′ N., long. 14° 51′ W.

Calanus gracilis, Dana.
valgus, n. sp.
Heterochæta spinifrons, Claus.
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Drepanopus furcatus, n. gen. and sp.
Ætidius armatus, n. gen. and sp.
Temora dubia (Lubbock).
Candace pectinata, Brady.
pachydactyla, Dana.
Setella gracilis, Dana.

Corycæus varius, Dana.
rostratus, Claus.
Saphirina metallina, Dana.
Oncæa obtusa, Dana.

STATION 348.—April 9, 1876. Lat. 3° 10′ N., long. 14° 51′ W. Net to 200 fathoms.

Calanus gracilis, Dana.
propinquus, n. sp.
Eucalanus attenuatus (Dana).
Undina vulgaris, Dana.
Euchæta prestandreæ, Philippi.
Candace pachydactyla, Dana.
Oithona challengeri, n. sp.
Ectinosoma atlanticum (B. and R.).
Setella gracilis, Dana.
Corycæus varius, Dana.
venustus, Dana.

STATION 349.—April 10, 1876. Lat. 5° 28′ N., long. 14° 38′ W.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Rhincalanus cornutus, Dana.
Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Drepanopus furcatus, n. gen. and sp.
Temora dubia (Lubbock).
Candace pectinata, Brady.
Oithona challengeri, n. sp.
Miracia efferata, Dana.
Corycæus varius, Dana.
Copilia mirabilis, Dana.
Lubbockia squillimana, Claus.
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.
Saphirinella stylifera (Lubbock).

STATION 350.—April 11, 1876. Lat. 7° 33′ N., long. 15° 16′ W.

Eucalanus attenuatus (Dana).
setiger, n. sp.
Undina vulgaris, Dana.
Heterochæta spinifrons, Claus.
Leuckartia flavicornis, Claus.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Temora dubia (Lubbock).
Acartia laxa, Dana.
Candace pectinata, Brady.
Oithona challengeri, n. sp.
Corycæus varius, Dana.
Oncæa obtusa, Dana.
Miracia efferata, Dana.
Saphirina inæqualis, Dana.

STATION 351.—April 12, 1876. Lat. 9° 9′ N., long. 16° 41 W.

Calanus gracilis, Dana.
Eucalanus attenuatus (Dana).
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Leuckartia flavicornis, Claus.
Temora dubia (Lubbock).
Candace pectinata, Brady.
Oithona challengeri, n. sp.
Setella gracilis, Dana.
Corycæus varius, Dana.
Oncæa obtusa (Dana).
Lubbockia squillimana, Claus.
Saphirina metallina, Dana.

STATION 352.—April 13, 1876. Lat. 10° 55′ N., long. 17° 46′ W.

Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
hessei, n. sp.

Temora dubia (Lubbock).
armata, Claus.
Leuckartia flavicornis, Claus.
Candace pectinata, Brady.
Acartia laxa, Dana.
Oithona challengeri, n. sp.
Miracia efferata, Dana.
Corycæus varius, Dana.
Copilia mirabilis, Dana.
Saphirina inæqualis, Dana.

April 26, 1876. St. Vincent, Cape Verde Islands.

Eucalanus setiger, n. sp.
Pleuromma abdominale (Lubbock).
Undina vulgaris, Dana.
Temora dubia (Lubbock).
Candace pectinata, Brady.
Pontella detruncata (Dana).
acutifrons (Dana).
Corycæus rostratus, Claus.
Oncæa obtusa (Dana).
Saphirina ovalis, Dana.
serrata, n. sp.

April 27, 1876. Lat. 17° 18′ N., long. 26° 32′ W.
Saphirina gemma, Dana.

April 28, 1876. Lat. 17° 47′ N., long. 28° 28′ W.
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Candace pachydactyla, Dana.
Pontella acutifrons (Dana).
strenua (Dana).
Saphirinella stylifera (Lubbock).

April 29, 1876. Lat. 13° 8′ N., long. 30° 5′ W.

Calanus valgus, n. sp.
Undina vulgaris, Dana.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Candace pachydactyla, Dana.
Saphirina ovalis, Dana.

Station 353.—May 3, 1876. Lat. 26° 21′ N., long. 33° 37′ W.

Calanus gracilis, Dana.
Hemicalanus longicornis, Claus.
Pleuromma abdominale (Lubbock).
Heterochæta spinifrons, Claus.
Leuckartia flavicornis, Claus.
Undina darwinii, Lubbock.
Scolecithrix danæ (Lubbock).
Euchæta prestandreæ, Philippi.
Centropages violaceus (Claus).
Candace truncata, Dana.
pachydactyla, Dana.
Oithona challengeri, n. sp.
Corycæus varius, Dana.
venustus, Dana.

May 7, 1876. Lat. 34° 22′ N., long. 34° 23′ W. Atlantic.

Calanus gracilis, Dana.
Pleuromma abdominale (Lubbock).
Euchæta prestandreæ, Philippi.
pulchra (Lubbock).

Sub-Class ENTOMOSTRACA, Müller (Gnathopoda, H. Woodward).

Order COPEPODA, Milne-Edwards.

Section I. Gnathostoma, Thorell.

Family I. Calanidæ, Dana.

Body elongated, consisting of from ten to twelve segments. Abdomen nearly cylindrical, much narrower than the cephalothorax, and prolonged at the posterior extremity into two more or less cylindrical caudal stylets. Head often continuous with the first segment of the thorax; fourth and fifth thoracic segments often coalescent. Head rarely divided into two segments, but not unfrequently showing an incomplete separation ("cervical suture"). Anterior antennæ very long, and composed of twenty-two to twenty-five (rarely fifteen, eighteen, or twenty) joints; that of the right side in the male often modified for grasping. Posterior antennæ large, composed of a basal joint, to which are usually attached two branches, the primary (external) consisting of two, the secondary (internal) of several joints. Mandibles strongly toothed at the apex, palp usually two-branched. Maxillæ strong, composed of a more or less quadrate biting portion, which bears numerous curved, setiform, marginal teeth, and a complex, many-lobed palp. Foot-jaws largely developed: anterior pair very broad, inner margins of the basal joints forming wart-like processes, from which spring long ciliated bristles; distal extremity divided into three short joints, which are beset with strong ciliated setæ; posterior pair longer and more slender, basal portion composed of two long and narrow joints, apical portion usually of four to six very small joints. First four pairs of feet two-branched, the outer branches (in the adult) almost always three-jointed. Fifth pair either like the foregoing, or remarkably different, and forming in the male powerful clasping organs, which are unlike on the two sides: those of the female, though often differing from the true swimming feet, always alike on the two sides. A heart is present. Eyes either median and stalked, or paired (lateral) and sessile; in the latter case often coalescent, and composed of several lenses and pigment-masses: situated usually near the front of the head, but in one genus (*Pleuromma*) near the base of the foot-jaw of one side only. Sexual organs in the female symmetrical, in the male asymmetrical; ovisac single, borne in front of the abdomen.

This family includes by far the larger portion of the pelagic Copepoda, being represented abundantly in all seas, from the equator to the poles—or at any rate, as near to those points as scientific investigation has yet been able to extend.

The overwhelming preponderance of this family in the open sea is at once apparent, when we note that out of the ninety species of free-living Copepoda found amongst

the Challenger gatherings, fifty-eight belong to the Calanidæ. On the other hand, there can be little doubt that had it formed part of the plan of the expedition to investigate fully the littoral fauna of the countries visited, we should have found the proportionate number of species reversed for that zone in favour of the Harpacticidæ. The Calanidæ, indeed, by virtue of their enormously-developed anterior antennæ (often equalling, or more than equalling, in length the entire body of the animal), are specially adapted for an entirely natatory life, those organs when spread out at right angles to the body acting like the wings of a hovering bird, and so suspending the animal at almost perfect rest in the water. In the Harpacticidæ, on the contrary, we find antennæ usually so short that they can be of very little use as swimming organs,—this function probably devolving almost entirely on the feet. And as a result of this structure, the members of the family haunt chiefly either the muddy sand of the sea-bed, or littoral situations, where there is abundance of weed, on the fronds of which they rest and find their food, swimming only fitfully and by short jerks.

Following the classification adopted in my Monograph of the British Copepoda,[1] I unite with the Calanidæ the species referred by Dr Claus to a separate family, Pontellidæ,—distributing the Calanidæ under two sub-families,—Calaninæ and Pontellinæ.

The fifty-eight species of Calanidæ taken by the Challenger belong to the following genera:—*Calanus*, *Eucalanus*, *Rhincalanus*, *Hemicalanus*, *Pleuromma*, *Heterochæta*, *Leuckartia*, *Undina*, *Scolecithrix*, *Euchæta*, *Calanoides*, *Ætidius*, *Drepanopus*, *Phyllopus*, *Temora*, *Centropages*, *Candace*, *Acartia*, *Corynura*, *Calanopia*, *Pontellopsis*, and *Pontella*.

Sub-family I. Calaninæ, Dana.

This sub-family is characterised by the presence of only one eye, which is sessile and made up of several lenses.

Calanus, Leach.

Calanus, Leach, Dict. Sci. Nat. XIV., Art. Entomostraca (1819); Dana, in part, Crust. U.S. Expl. Exped. (1852), Boeck, Oversigt Norges Copepoder (1864); Lubbock passim; Brady, Monog. Brit. Copep. (1878).
Cetochilus, Roussel de Vauzème, Claus, Baird, Goodsir.
Monoculus, Günner, Act. Hafn. (1765).

Cephalothorax elongated, slender, composed of five or six segments; head usually separate from the thorax, and often more or less distinctly divided near the middle by a transverse "cervical suture"; rostrum attenuated and bifid. Eyes small, situated at the back of the head, near the middle line, each composed of two lenses. Anterior antennæ long, composed of twenty-five joints, alike on the right and left sides in both

[1] Ray Society, 1878.

sexes, and possessing no hinge joint: those of the male are provided with thickened, club-shaped appendages, and the joints are often slightly narrowed at the base. Posterior antennæ two-branched, the secondary branch having three or four small intercalated median joints. Maxilla composed of a broad masticating portion, which bears a series of stout, short setæ, and a foliaceous, multifid palp made up of several digitiform segments, all of which bear numerous long and finely ciliated setæ. Mandibles large and strong, dilated and strongly toothed at the apex; basal joint of the palp large and widened towards the apex, from which spring two nearly equal branches, composed (usually) of two, and three or four, joints respectively. Anterior foot-jaws broad and strong, provided with several marginal processes which bear strong curved setæ; posterior foot-jaws elongated, composed of two large basal and five smaller apical joints, all of which bear long setæ. Five pairs of two-branched feet adapted for swimming, each branch composed of three joints; in the male, however, the outer branches of the fifth pair on one or both sides are somewhat modified. Abdomen of the male five, of the female four-jointed.

The genus *Calanus* was established by Leach for the reception of the species called by Müller, in his Entomostraca, *Cyclops longicornis*, and in the Zool. Dan. Prodr. *Cyclops finmarchicus*, and identified by that author with Günner's *Monoculus finmarchicus*. It is impossible to say certainly what is the species referred to in Müller's figure. The caudal part has, I think, undoubtedly been drawn from *Temora finmarchica*, Baird, while the antennæ are much too long for that species, and are probably taken from *Cetochilus septentrionalis*, Goodsir, which species seems also to be meant in the description:—"Antennæ,—corpore longiores." But Günner's figures, from the general contour of the animal, the length of the antennæ, and the characteristic long subapical setæ, certainly belong to *Cetochilus septentrionalis*. I therefore follow Boeck in assigning the generic term *Calanus* to the form originally described by Günner, discarding the later name *Cetochilus*. Baird's *Temora finmarchica* will in this case stand as the type of the genus *Temora*. In accordance with this view it is impossible to accept Dr. Baird's identification of his *Temora finmarchica* with Günner's species. And though the generic name *Temora* holds good, it seems best, considering the doubt which must rest upon the meaning of Müller's figure, to discard the name *longicornis* (adopted by Boeck and by myself in the Monograph of the British Copepoda—from Müller) and to accept that of *longicaudata* proposed in 1857 by Sir John Lubbock. I have thought it best to give in detail my reasons for this nomenclature, inasmuch as a different course is advocated by Dr. Claus, and, I think, by Giesbrecht.

As understood by Dana, this genus includes a great number of species properly referable to several distinct genera, notably to *Calanus* (proper), *Hemicalanus*, *Eucalanus*, and *Temora*, but it is not possible in many cases to assign Dana's species to their true position, the published details being insufficient for that purpose. The presence of five pairs of well-developed swimming feet in both sexes, and the peculiar modification of the fifth pair

in the male, the twenty-five jointed anterior antennæ, together with the characters of the posterior antennæ and mouth-organs, are the characters upon which rest the claims of *Calanus* to generic rank. The species are probably very numerous, and are found near the surface of the sea in all parts of the world. In some species, though perhaps not in all, there is a remarkable difference between the posterior foot-jaws of male and female, those of the male being somewhat smaller, stouter, and armed on the outer margin, near the apex, with two or more stout and profusely plumose recurved setæ.

1. *Calanus finmarchicus* (Günner) (Pl. I. figs. 1–10).

Monoculus finmarchicus, Günner, Act. Hafn. x., 175, figs. 20–23 (1765).
Cetochilus septentrionalis, Goodsir, Edin. New Phil. Journ. 35, p. 339, t. vi. figs. 1–11 (1843).
„ „ Baird, Nat. Hist. Brit. Entom., p. 235, t. xxx., figs. 1 *a–g* (1850).
„ *helgolandicus*, Claus, Die frei lebenden Copepoden, p. 171, t. xxvi., figs. 2–9 (1863).
Calanus finmarchicus, Boeck, Oversigt over de ved Norges Kyster iagttagne Copepoder, p. 8 (1864), Brady, Monogr. of the Copepoda of the British Islands, vol. i. p. 38, pl. i. figs. 1–12 (1878).
Calanus magnus, *borealis* and *elegans*, Lubbock, Ann. Mag. Nat. Hist., ser. 2, vol. xiv. (1854).

Length, 1-7th of an inch (3·5 mm.).[1] Forehead broadly rounded, rostrum long, slender and bifid, anterior antennæ twenty-five jointed, as long as the body, each joint bearing two or three short setæ (except those near the base in the female), the twenty-third and twenty-fourth joints each with a long apical seta; most of the joints of the male antenna (fig. 1) are constricted at the point of articulation, and bear fusiform or club-shaped appendages at the apices. The branches of the posterior antennæ (fig. 3) are stout and nearly equal; those of the mandible-palp (fig. 4) are short and nearly equal, one indistinctly four-jointed, the other two-jointed, with the first joint much swollen. The swimming feet are long and slender, terminal spines slender and without serratures (fig. 9), the first joint of the peduncle of the fifth pair, in both sexes, has its inner margin bordered with about fifteen sharp teeth of equal size throughout; the outer branch of the right side, in the male, has its first two joints much elongated (fig. 10), equalling in length the three joints of the left limb; the last joint is much shorter, ovate, and bears three or four small slender setæ near its apex. The mouth is provided with two very strongly toothed lips (fig. 5).

Habitat.—Taken in the tow-net, off Cape Howe, Australia, at night, and in lat. 36° 32′ S., long. 132° 52′ W. (Station 287).

In my preliminary notes and drawings of these Australian specimens, I set the species down as undescribed, relying upon the marked moniliform character of the anterior male antennæ, and the peculiar reflexed setæ of the posterior foot-jaw in the same sex. But further examination of northern specimens has showed me that both those characters, not

[1] The measurements are always exclusive of the tail setæ.

hitherto noticed, I believe, by any author, are equally well developed in the typical *Calanus finmarchicus* of the North Sea. Such examples as have usually come under my notice, taken off the east coast of England, or in other places very near to the English coast, are comparatively small, and have their salient characters not strongly marked; but I have recently had the opportunity of examining specimens collected in more northern latitudes, during the cruise of the "Knight Errant,"[1] and I cannot see that these differ in any respect from the southern form. Thus, the only reasonable course is to consider both the northern and southern forms as belonging to one species, probably the most abundant and most widely distributed of all the Copepoda. In the arctic regions it is known to be very abundant, and the specimens described by Roussel de Vauzème from the antarctic seas are identically the same. I do not know, however, of its occurrence in the warm seas of the tropics.

Though this species has already been frequently described and figured, I have thought it best to give drawings of some of the most distinctive characters as seen in southern specimens. The figures have all been drawn by aid of the camera lucida.

2. *Calanus valgus*, n. sp. (Pl. III. figs. 1–7).

Length, 1-7th of an inch (3·5 mm.). Forehead broadly rounded, rostrum long and slender; head incompletely separated from the thorax (fig. 1). Anterior antenna rather longer than the cephalothorax, its setæ distributed as in *Calanus finmarchicus*. Posterior antennæ and mouth organs as in *Calanus finmarchicus*. Swimming feet very long and slender, their marginal spines longer than in the preceding species. The right fifth foot of the *male* (fig. 5) is not very much longer than the left, but the marginal spines of the first and second joints are very long,—longer indeed than the joints themselves; the third joint bears a comparatively short apical spine; the inner branch is destitute of setæ, but bears small marginal spines; the foot of the right side (at any rate in spirit specimens) is usually flexed at a right angle, as shown in fig. 6; basal joint of the peduncle finely serrated on the inner margin. All the joints of the *male* abdomen are nearly equal (fig. 7), but in the *female* (fig. 1) the first two joints are much longer than the following two.

Habitat.—Off Cape Howe, Australia, at night; in the Arafura Sea, in several South Pacific Stations (287, 288, 295, 296, 299) between lat. 38° S., long. 94° W., and lat. 33° 31′ S., long. 74° 43′ W.; in lat. 36° 9′ S., long. 48° 22′ W. (Station 324, South Atlantic), and in lat. 3° 10′ N., long. 14° 51′ W. (Station 348, North Atlantic). The gathering from Station 296 consisted entirely of this species, and in several others it was also tolerably abundant.

[1] Exploration of the Faröe Channel during the summer of 1880, in Her Majesty's hired ship "Knight Errant," Staff-Commander Tizard and John Murray, *Proc. Roy. Soc. Edin.*, vol. xi. pp. 638, *et seq.* 1882.

3. *Calanus propinquus*, n. sp. (Pl. II. figs. 1–7, and Pl. XIV. figs. 10, 11).

Length, 22-100ths of an inch (5·5 mm.). Head indistinctly separated from the thorax; forehead broad and obtuse, thorax narrowed towards the posterior extremity, and terminating in acute lateral angles. Caudal stylets oblong, divergent, about twice as long as broad; setæ densely plumose, about as long as the abdomen, except the second, which is about three times as long. Anterior antennæ very little longer than body, and (in spirit specimens) often curled round the back; the penultimate and antepenultimate joints have each an extremely long ringed and plumose seta. Branches of the posterior antennæ of equal size. The basal joint of the peduncle of the fifth pair of feet bears a row of several (about fifteen) serratures on its inner margin, the last four or five being larger than the rest, and situated on the distal angle of the joint;[1] marginal spines of the swimming feet rather small and slender, terminal spine slender, and devoid of serratures, and slightly bent at the apex; in the *male* the fifth foot of the right side has its outer branch very long, the first joint as long as the whole of the inner branch, the second joint still longer, the third small, subovate, and bearing a slender terminal spine; spines of the outer margin of the limb obsolete, the inner branches of both sides are destitute of setæ. The basal serratures in the *male* are of uniform size.

Habitat.—I have noticed this species in the following gatherings:—Lat. 46° 46′ S., long. 45° 31′ E. (Station 146); lat. 64° 37′ S., long. 85° 49′ E. (Station 154); and in lat. 47° 25′ S., long. 130° 12′ E.; and between Stations 298 and 299 (South Pacific); in lat. 35° 41′ N., long. 157° 42′ E. (Station 241); lat. 40° 3′ S., long. 132° 58′ W. (Station 288); and in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); in lat. 3° 10′ N., long 14° 51′ W. (Station 348); off Kerguelen Island; and in lat. 37° 17′ S., long 53° 52′ W. (Station 320).

4. *Calanus tonsus*, n. sp. (Pl. IV. figs. 8, 9).

Female.—Length, 1-7th of an inch (3·6 mm.). Like *Calanus finmarchicus* and *Calanus propinquus*, except that the anterior antennæ (fig. 8) are almost entirely devoid of setæ except on the three apical joints, those of all the other joints being almost imperceptible; the posterior antennæ are setiform along almost the whole length, like those of *Calanus propinquus*. The fifth pair of feet have no basal serratures, and the first segment of the *female* abdomen is large and tumid (fig. 9). The anterior antennæ are as long as the body of the animal. No *males* were seen.

Habitat.—Taken abundantly in the tow net in lat. 38° 6′ S., long. 88° 2′ W. (Station 296), and in another gathering from the same latitude, but about 4 degrees further west; also in lat. 35° 41′ N., long. 157° 42′ E. (Station 241); about lat. 40° S., long. 132° W. (near Station 288); in lat. 39° 22′ S., long. 98° 46′ W. (Station 294); in lat.

[1] The figure of the entire foot in Pl. II. has been drawn from a limb placed in a distorted position, and gives an incorrect idea of the arrangement of the spines.

36° 9′ S., long. 48° 22′ W. (Station 324); lat. 36° 44′ S., long. 46° 16′ W., at a depth of 650 fathoms, from the dredge (Station 325).

Although this species is certainly very nearly allied both to *Calanus finmarchicus* and *Calanus propinquus*, I am unable, on account of the differences noted above, to refer it to either of them. It does not seem likely that these differences depend upon immaturity, seeing that the specimens appear to be of full size, and are perfect as to the number of joints in the swimming feet, where, if at all, we ought to find signs of imperfect development. Besides the two species here mentioned, *Calanus tonsus* might not unreasonably be referred to several of Dana's species, notably to *rotundatus*, *comptus*, *nudus* or *magellanicus*. But in all these cases certain descriptive details given by Dana throw doubt upon the propriety of such identification. Some of the points of divergence are these:—In *rotundatus* the antennal setæ are stated to be "short, those near the base scarcely longer than the diameter;" in *comptus* the antennæ are "a little longer than the cephalothorax;" in *nudus* the "abdomen is apparently three-jointed, yet the first articulation is somewhat uncertain, antennæ scarcely longer than the cephalothorax;" and in *magellanicus* there are only "four pairs of natatories, the fifth rudimentary."

5. *Calanus gracilis*, Dana (Pl. V. figs. 1–6; and Pl. XLVI. fig. 1).

Calanus gracilis, Dana, Crust. U. S. Expl. Exped., p. 1078, pl. lxxiv. fig. 10.

Length, 1-7th of an inch (3·6 mm.). Anterior antennæ about once and a-half the length of the body, slender, sparingly clothed with very short setæ, except the penultimate and antepenultimate joints, each of which bears an excessively long, ringed, and densely plumose seta. The outer branches of the third and fourth pairs of swimming feet in the *male* have the margin of the last joint, between the base and the median spine, strongly serrated (Pl. V. fig. 5); in the *female* the same space is finely ciliated (fig. 4); the terminal spines of the feet are simply sword-shaped, the serrations of the edge scarcely perceptible: in the first foot, however, there is, as usual, no spine, but the outermost seta of the external branch (Pl. V. fig. 3, and Pl. XLVI. fig. 1) is widened near the base, where it forms a harpoon-like process, and the first joint is produced quite at the base into two short, stout, divaricate spines, and has also a curious appendage, in shape somewhat like the letter *f*, slightly prominent, about half the length of the limb, and laid lengthwise along its basal half. This is plainly seen without any dissection, and is quite diagnostic of the species. The fifth foot of the *female* does not differ from the rest, but on the right side in the *male* (fig. 6) is of abnormal form, while that of the left side is normal. The abdomen is short, scarcely one-third the length of the cephalothorax, caudal stylets about as long as broad, setæ short and subequal, except the second, which is nearly as long as the whole body of the animal. All the setæ of the swimming feet are distinctly jointed in the middle.

Habitat.—This species occurred in moderate numbers in surface-net gatherings from many different localities:—"Lat. 26° 21′ N., long. 33° 37′ W., down to 80 fathoms, May 3, 1876;" and near the Philippine Islands, January 1875; also between Api and Cape York; off Port Jackson, at night; off Kandavu, Fiji; in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); and in several North Atlantic gatherings between lat. 3° 10′ N., long. 14° 51′ W., and lat. 9° 9′ N., long. 16° 41′ W. (Stations 348–351). I cannot be quite certain that this is rightly assigned to Dana's *Calanus gracilis*, though his description and figures contain nothing inconsistent with that supposition. Even if this be the case, it is more than probable that future research will render necessary the formation of a new genus for the reception of this and other allied forms. At present I have seen only one male specimen, and am unable to speak with confidence as to the structure of the fifth feet, which were not very distinctly made out. But I can scarcely doubt that they are distinct from those of the typical *Calani*.

6. *Calanus princeps*, n. sp. (Pl. IV. figs. 3–7).

Female.—Length, half an inch (12·5 mm.). Anterior antennæ (fig. 4) longer than the body, slender, sparingly setiferous, the basal joints, as far as the eighth, very short, the rest very long,—mostly four or five times as long as broad,—except the twenty-fourth, which is short, and bears on the middle of its inner margin an excessively long plumose seta. the branches of the mandible-palp are very short, equal, the outer having two, the inner three joints. The maxilla-palp (fig. 5) is made up of fewer segments than usual, having one quadrate and two ovate plates, together with a single, small bisetose digit. The anterior foot-jaws are armed with strong, curved setæ, which are densely clothed on their inner margins with short, delicate, and closely set hairs (fig. 6), except towards the base, where the setæ are naked. The joints of the outer branches of the swimming feet (fig. 7) are much constricted at the base, the marginal spines are short and stout, the terminal spines very slender, with finely serrated margin. The setæ, both of feet and mouth-organs, are all densely feathered with long, brownish cilia. The colour of the body is a deep reddish-brown. The abdomen is short, stout, and three-jointed.[1]

Habitat.—This fine species—the largest, so far as I know, of the Calanidæ—occurred in two dredgings, but only one specimen was found in each locality. Station 45, lat. 38° 34′ N., long. 72° 10′ W.; depth, 1240 fathoms; bottom temperature, 2° 4′ C.; mud.—Station 50, lat. 42° 8′ N., long. 63° 39′ W.; depth, 1250 fathoms; bottom temperature, 2° 8′ C.; grey ooze.

[1] Since this description was written, Mr. Murray has sent me a drawing made by Dr. von Willemöes-Suhm from a freshly taken specimen. A memorandum on the drawing states that the animal was found "on the swabs of the dredge (surface?) on May 3, 1873, depth 1250 fathoms, off Sandy Hook, North America, lat. 38° 34′ N., long. 72° 10′ W." I am disposed to think, seeing that all the specimens have been obtained from the dredge, that this species is really an inhabitant of the deep sea, and not casually entangled by the dredge on its way to the surface.

I refer these specimens, only provisionally, to the genus *Calanus*, from which they differ in some important particulars,—in the structure of the maxilla-palp, and in the presence of only three segments in the female abdomen. But as the male is unknown, and as the structure of the maxillæ in allied species has scarcely as yet received sufficient attention, it seems best, for the present, to defer any attempt to frame a complete generic definition.

Eucalanus, Dana.

Eucalanus and *Calanus* (in part) Dana, Crust. U. S. Expl. Exped. (1852.)
Calanus, Lubbock, Trans. Entom. Soc. (1856.)
Calanella, Claus, Die frei lebend. Copep. (1863.)

Body straight, slender and elongated; anterior portion of the head much attenuated and elongated; forehead triangular, prominent, rostrum very slender and furcate. Last four thoracic segments very small. Anterior antennæ composed of twenty-three or twenty-four joints, bearing (in the male) numerous club-shaped appendages; setæ small, except towards the apex. Inner branch of the posterior antennæ seven or eight-jointed, shorter than the outer branch. Mandible palp composed of one large and one very small two-jointed secondary branch. Anterior foot-jaws of moderate size, posterior excessively long. Four pairs of feet in the female, five in the male, the fifth pair one branched and prehensile. Eyes small, simple. Abdomen short, composed of four joints in the male, of three in the female.

The anterior portion of the body, composed of the head and first thoracic somite, is extremely long,—more than twice the length of the rest of the body (Pl. VI. fig. 1); the forehead, from which springs the rostrum, forms a triangular projection between the two rounded, somewhat bulbous sides, behind which there is a slightly constricted neck (fig. 2). The animal, though large, seems to be excessively fragile, at any rate in its antennæ and feet, the antennæ especially being often broken away so as to leave visible only a very small portion of their original length. The smaller branch of the posterior antennæ (fig. 4) is fusiform, eight-jointed, the first two joints being large, the last six small and gradually tapering towards the apex; the larger branch is two-jointed, large, and bears long terminal setæ. The mandibles (fig. 5) are broad and numerously toothed at the apex, the basal joint of the palp very large, the apical portion much smaller, and composed of four joints; to the basal joint is attached a very small two-jointed branch, which bears three apical setæ. The maxillæ (Pl. II. fig. 8) are very large, and their distal segments are more than usually elongated. The anterior foot-jaws (Pl. VI. fig. 6) have the normal form, but according to Claus, are more powerfully armed in the female than in the male, the lateral segments unusually large. The posterior foot-jaws are very large, in the female six-jointed (Pl. II. fig. 9), elongated, and not differing much from the normal form; in the male (Pl. VI. fig. 7)

smaller and not so slender, the setæ stouter than in the female, shorter, and recurved. The four pairs of swimming feet are very short, nearly alike, the inner branches about half the length of the outer, and three-jointed, except in the first pair, where they have only two joints. The fifth pair is absent in the female, but in the male exists in the shape of two small, unequal, simple prehensile limbs (Pl. II. fig. 10). The abdomen is extremely short, scarcely more than one-sixth or one-seventh of the length of the cephalothorax. The second tail-seta, on the left side only, is much longer than the rest, and is about equal to the length of the body of the animal.

I have seen two species referable to this genus, both of which occurred in considerable numbers in several of the Challenger gatherings.

In his great work on the Crustacea of the United States Exploring Expedition, Prof. Dana remarks respecting *Calanus attenuatus*, that "the multiarticulate character of the smaller branch of the posterior antennæ may authorise the institution of a new genus, or sub-genus, for this and allied species, for which we propose the name *Eucalanus*. The above species will be *Eucalanus attenuatus*." And though Dana does not himself adopt that suggestion, but calls the species *Calanus attenuatus*, it yet seems to me that the name proposed by him, though in this hesitating way, may fairly claim precedence over the later generic term of Dr. Claus. I therefore accept *Eucalanus* as the proper name of the genus, which was very rightly separated by Claus from *Calanus*, on account not only of the general peculiarity of its external form, as shown in the peculiarly attenuated head, very long body, and stunted abdomen, but also on account of the abnormal structure of the antennæ, mandible-palp, and posterior foot-jaws, together with the absence of a fifth pair of feet in the female. These characters are certainly amply sufficient to sustain "*Calanella*" as a distinct generic form. And it seems pretty clear, as pointed out by Claus, that some species of "*Calanus*" described by Dana and Lubbock (*e.g.*, *Calanus elongatus*, Dana; *Calanus attenuatus*, Dana; *Calanus danæ*, Lubbock; and *Calanus mirabilis*, Lubbock) belong to "*Calanella*."

1. *Eucalanus attenuatus*, Dana (Pl. VI. figs. 1–8, and Pl. II. figs. 8–10).

Calanus elongatus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1079, pl. lxxv. fig. 1.
Calanus attenuatus, idem, ibidem, p. 1080, pl. lxxv. fig. 2.
Calanus mirabilis, Lubbock, Trans. Entom. Soc., vol. iv. (1856), pl. v. figs. 1–6; and Trans. Linn. Soc., vol. xxiii. p. 178, pl. xxix. fig. 1.
Calanella mediterranea (?), Claus, Die frei lebenden Copepoden (1863), p. 176, pl. xxviii. figs. 6–11.

Length, 1–6th of an inch (4·2 mm.). Rostrum small (Pl. VI. fig. 3), divided at the apex into two long and slender, thread-like filaments. Anterior antennæ twenty-three jointed, about one-third longer than the body, sparingly setiferous, but bearing numerous short club-shaped appendages; seventh joint longer than those immediately preceding or following it; the last joint armed with three or four, the penultimate and

antepenultimate each with two long apical setæ. In the *male* the joints are constricted at the points of articulation. I have altogether failed to find the beautifully plumose hairs figured by Lubbock and Dana as belonging to the apex of the anterior antennæ. Inner branch of the posterior antenna eight-jointed, the two basal joints large, last six joints very small and nearly equal. The inner branches of all the swimming feet (fig. 8) are three-jointed; the marginal spines of the outer branches small; terminal spines very slender, scarcely distinguishable from the marginal setæ, but bordered externally with a very delicate faintly pectinated lamina. The feet of the fifth pair in the *male* (Pl. II. fig. 10) are three-jointed, the left limb longer than the right, each bearing a single small apical hair. In the *female* the posterior foot-jaws (fig. 9) have the three proximal tufts of setæ only plumose.

Habitat.—Between Api and Cape York; between Arrou and Banda; off the south of Papua; off Sibrabo Island, Philippines, and in various other gatherings from amongst the Philippine Islands; in lat. 46° 46′ S., long. 45° 31′ E. (Station 146); lat. 47° 25′ S., long. 130° 32′ E. (Station 159); off Port Jackson, at night; between Sydney and Wellington; off Kandavu, Fiji; in the tropical Atlantic off the west coast of Africa, between lat. 3° 10′ N., long. 14° 51° W. (Station 348); and lat. 7° 33′ N., long. 15° 16′ W. (Station 350); and in lat. 45° 31′ S., long. 78° 9′ W. (Station 303).

It will be seen from the foregoing list, that almost all the Challenger gatherings in which this species was noticed, are from the Malayan and Australasian Seas, the exceptions being those from the west coasts of Patagonia and Africa. Professor Dana's specimens, however, were from the Pacific (Kingsmill Islands) and China Seas; Sir John Lubbock's from the Bay of Biscay, and Dr. Claus's (which as I think are in all probability identical with the present species) from the Mediterranean. There can scarcely be a better instance of the very wide distribution of a species, which is nowhere perhaps very abundant when compared with such as *Calanus finmarchicus*, *Anomalocera patersonii* or *Undina vulgaris*. Further research may perhaps show differences sufficient to require specific recognition, but if so, the relationship between the various species may be expected to be very close indeed, showing not greater divergence than might be the result of prolonged exposure to somewhat different external conditions. The anterior antennæ (Pl. VI. fig. 1) are inaccurately drawn, showing too large a number of joints. When the figure was drawn I had not seen a specimen with perfect antennæ, and the drawing was made up from observations of several animals: the number of joints ought to be twenty-three.

2. *Eucalanus setiger*, n. sp. (Pl. III. figs. 8–15).

Length, 1·7th of an inch (3·5 mm.). Forehead broadly rounded, with little or no constriction behind, rostrum with a long, stout base and slender bifid apex; head not at

all attenuated, distinctly separated from the thorax, and constricted at the point of junction. Anterior antennæ somewhat longer than the body of the animal, twenty-four jointed, clothed with very short setæ, two or three on each joint, and with a single, rather longer, rigid seta at the apex of the second, third, eighth, thirteenth, fifteenth, and seventeenth joints; the last two joints bear a lash of setæ of moderate length; in the *male* the antennal joints are constricted at the bases. Posterior antennæ slightly different in the two sexes, as in *Eucalanus attenuatus* (figs. 9, 10). Basal joint of the mandible-palp (fig. 11) short and broad, outer branch composed of only one joint, inner branch small and two-jointed. Maxillæ and foot-jaws asin *Eucalanus attenuatus*. The swimming feet (fig. 12) have no terminal spines; all the inner branches are two-jointed, except those of the first pair, which are one-jointed (?). Those of the fifth pair of the *male* are very slender (fig. 13), simple, and composed of five joints, the last of which is small and setiform. The last two thoracic segments bear each a slender, divaricate lateral seta (fig. 14). The abdomen of the *female* is extremely short and three-jointed, that of the *male* (fig. 15) four-jointed.

Habitat.—Between Sydney and Wellington; Arafura Sea; off Sibrabo Island and Zebu Harbour, and at two other stations (*circa* 201, 202) amongst the Philippine Islands; off St. Vincent Islands, Cape Verde; in lat. 7° 33′ N., long. 15° 16′ W. (Station 350); and in lat. 34° 37′ N., long. 140° 32′ E. (east of Japan, Station 237).

In general appearance this is deceptively like the male *Calanus finmarchicus*, and affords a remarkable instance of homomorphism—perhaps even of mimetic resemblance—between two certainly distinct genera. I do not remember to have seen amongst the Calanidæ any other so well marked example of this condition. Without minute examination, the only palpably distinctive character is the somewhat greater length of the antennæ of *Eucalanus*. The two genera, however, differ essentially in the structure of the posterior antennæ and the fifth pair of feet.

Rhincalanus, Dana.

Animal slender and elongated, cephalothorax many times as long as the abdomen; head and thorax coalescent, five-jointed; anterior part of the head produced. Anterior antennæ alike in both sexes, much longer than the body, bearing numerous short and a few very long setæ; inner branch of the posterior antennæ multiarticulate, the last five joints very short and nearly equal. Mandibles broad and strongly toothed at the apex; palp well developed, with a large basal joint and two branches, one composed of two, the other of three joints. Maxillæ and foot-jaws nearly as in *Calanus*. Swimming feet, five pairs, short; inner branches of the first four pairs small and three-jointed, except in the first pair, which has only two joints; fifth pair one or two-branched. Abdomen four-jointed.

Dana separated this form from its relatives, and gave it generic rank, simply on the strength of its strongly produced rostrum, a character certainly insufficient of itself to maintain the generic distinction. But as the fifth pair of feet (at any rate in *Rhincalanus gigas*) presents some differences of structure, I have retained, provisionally, Prof. Dana's name, though with much doubt as to the propriety of doing so.

1. *Rhincalanus cornutus*, Dana (Pl. VII. figs. 1–10).

Rhincalanus cornutus, Dana, Crust. U. S. Expl. Exped., p. 1083, pl. lxxvii. fig. 2, *a.d.*

Female.—Length, 1-7th of an inch (3·5 mm.). Forehead very much produced, attenuated, terminated by a triangular, slenderly furcate rostrum, between which and the anterior part of the head, as seen laterally, is a deep sinus; cephalothorax four or five times as long as the abdomen, and very slender; the posterior margins of all except the first and last segments produced at each side into a sharp, backward-pointing spine. Anterior antennæ about one-fourth longer than the body, twenty-three-jointed, the basal joint very long, one very long marginal seta near the base, one on the twelfth, fourteenth, sixteenth, nineteenth, and twenty-first joints, two on the twenty-second, and a lash of four or five at the apex of the last joint. Posterior foot-jaws (fig. 7) of no great length, and in structure like those of *Calanus;* peduncle two-, flagellum five-jointed. Inner branches of the first pair of swimming feet two-jointed (fig. 8), second joint of the peduncle swollen at the inner side, and bearing a setose tuft; outer branch bearing three ciliated spines. The second, third, and fourth swimming feet have their inner branches three-jointed, the outer branches destitute of marginal spines (fig. 9), except the first joint, the outer margin of which is swollen and produced into an apical tooth; the terminal spines of the swimming feet are long, very slender, and have an extremely delicate hyaline lamina extended along the outer margin, but are in no other respect distinguishable from the neighbouring setæ. Fifth pair of feet (fig. 10) simple, three-jointed, short, the last joint bearing two apical spines of unequal length, the larger of which is marginally ciliated. Abdomen four-jointed (three-jointed, Dana), first segment about as long as the following three, and spined at its postero-dorsal angle. Caudal laminæ about twice as long as broad, setæ about as long as the abdomen, except the second on the left side, which is twice as long as the rest.

That the specimens above described are females, I conclude, from the fact of spermatophores having been seen attached to the abdomen of some of them. Amongst all the specimens I have not been able to find any difference which appeared to me to be sexual, except that in one or two no fifth pair of feet was discernible. I think, however, that these examples were probably immature. It will be noticed that the number of segments

figured in the cephalothorax and abdomen differs in the two specimens represented in the plate (figs. 1 and 2). These were drawn as they appeared under the microscope. The differences may perhaps be sexual, but of this I could find no evidence.

Habitat.—Off Sibrabo Island, and in several other localities amongst the Philippine Islands; and in lat. 5° 28′ N., long. 14° 38′ W. (Station 349). Dana's specimens were collected in the Sulu Archipelago.

2. *Rhincalanus gigas*, n. sp. (Pl. VIII. figs. 1–11).

Female.—Length of the body one-third to three-eighths of an inch (8·5–10 mm.). Anterior antennæ twenty-three-jointed, nearly as in *Rhincalanus cornutus*, but with somewhat shorter marginal setæ. Forehead not so much elongated as that of *Rhincalanus cornutus*. Ventral angles of the last three thoracic segments produced into overlapping spines. Abdomen composed of four segments, the first and last of which form spinous processes at their postero-dorsal angles. The inner branches of the swimming feet are three-jointed, the outer branches very feebly spinous, the spines, as in *Rhincalanus cornutus*, being merely small, unjointed processes of the limb, in the last joint amounting to little more than marginal crenulations (fig. 8). The feet of the fifth pair (figs. 9, 10) are one or two (?) branched, the terminal joint bearing three, the penultimate joint one apical seta. Caudal stylets about as long as broad, setæ subequal (fig. 11).

Habitat.—*Rhincalanus gigas*, though distributed over a very wide area, seems to be much more abundant in the southern hemisphere than in more northern latitudes. The following list indicates the localities in which it was taken by the surface-net during the cruise of the Challenger:—In lat. 65° 42′ S., long. 79° 49′ E., 80 fathoms (Station 153); lat. 64° 37′ S., long. 85° 49′ E. (Station 154); lat. 47° 25′ S., long. 130° 32′ E. (Station 159); near Station 206, January 9, 1875; lat. 37° 17′ S., long. 53° 52′ W. (Station 320); lat. 36° 44′ S., long. 46° 16′ W. (Station 325); and between Japan and Honolulu.

This species differs from *Rhincalanus cornutus* chiefly in size, being more than twice as long; also in the less attenuated forehead, in the situation of the thoracic spines (which are on the ventral surfaces of the somites instead of on the dorsal), and in the characters of the fifth pair of feet. Fig. 9 in the plate represents, I believe, the normal form of that limb, but in another specimen it was found as in fig. 10. No perfect anterior antennæ were seen, but those shown in the figure are probably nearly, if not quite, correct. The terminal spines of the swimming feet are very slender and scarcely distinguishable from the marginal setæ. The specimens here described are probably females, in which case the male has yet to be discovered.

Hemicalanus, Claus.

Hemicalanus, Claus, Die frei lebenden Copepoden, 1863 (not *Hemicalanus* of-Dana).

Body pellucid, somewhat depressed, eyes entirely wanting (?). Anterior antennæ twenty-five jointed, that of the left side in the male slightly geniculated. Posterior antennæ elongated, secondary branch five or six-jointed, the median joints minute and sometimes not distinctly separate. Mandibles almost styliform, two-toothed. Anterior pair of foot-jaws elongated, posterior still longer, robust. Fifth pair of feet two-branched, those of the female like the preceding pairs, as also those of the male,[1] except that the outer branch is uncinate. Abdomen short, composed in the male of five, in the female of four segments.

Of this remarkable genus I have seen but few examples, most of which were very imperfect. The foregoing definition is therefore copied almost verbatim from Dr. Claus, though in some points it does not quite agree with my own observation, to which, however, I cannot in this case allow much weight. In the best of the Challenger specimens (figured in Pl. IX. fig. 1) there were two small closely-approximated spots on the front of the head, which I took to be eyes, and I was unable, except in one specimen, to make out more than two joints in the secondary branch of the posterior antenna. The joints of the anterior antennæ were also very indistinctly visible, and those organs, as shown in fig. 1, are evidently imperfect.

The genus as originally constituted by Dana contains species probably belonging to two or more genera, and is certainly in that form untenable. It is impossible, indeed, from the insufficiency of the published characters, to say with certainty where the species assigned to it should properly be placed. None of them can be referred to *Hemicalanus* as understood by Claus, and upon which he makes the following remarks:[2]—"This genus, of which five species are known to me—on account of its delicate structure, the transparency of its body, and its several peculiarities of organisation—ranks amongst the most beautiful and interesting of all the Calanidæ. The entire body is extremely slender, like that of *Calanella* (*Eucalanus*), but broader and flatter; the abdomen is smaller and more slender but completely segmented, composed in the female of four, or rarely three, and in the male of five segments; the last segment, bearing the furca, is broad, and often produced, fan-like at the sides. In the species known to me, the cephalothorax is composed of four segments only, the head and first thoracic, as well as the two hindmost segments of the body, being coalescent. . . . The male antenna is hinged between the nineteenth and twentieth joints, but there is no marked swelling of the foregoing joints. The posterior antennæ are largely developed, the main branch of great length, and

[1] I cannot reconcile this statement of Dr. Claus with my observation of the fifth pair of feet in the Challenger specimen, which were as represented in fig. 1.

[2] Die frei lebenden Copepoden, p. 177. The translation here given is an abstract only of the more important parts.

bearing long, plumose apical setæ; the secondary branch usually much shorter, and shewing an elongated basal joint, with four incompletely separated median joints. Not less interesting is the form of the mandibles, the biting part of which is very slender, almost stylet-shaped, and terminates in two long, sharp teeth; the palp consists of an elongated peduncle, with two well-developed branches. . . . The maxillæ, instead of having as in *Calanus* a short lappet-like appendage, show an elongated rod-like process, bearing at its apex two excessively long and usually plumose setæ. . . . The fifth pair of feet of the male differ from those of the female in the conversion of the extremity into a prehensile organ; the outer branch of both feet is destitute of setæ, but has at the apex a claw, and the foot of the right side differs still further in having its penultimate joint excavated on the inner border, while the last joint has its marginal spine much enlarged and turned inwards."

That Claus should have found five species of *Hemicalanus* in the Mediterranean seems very remarkable, inasmuch as three forms only were noticed in the Challenger gatherings which passed through my hands, and they were represented only by about half-a-dozen specimens in all.

1. *Hemicalanus longicornis*, Claus (Pl. IX. figs. 1–7).

Hemicalanus longicornis, Claus, Die frei lebenden Copepoden, p. 179, pl. xxix. fig. 1.

Length, 1-10th of an inch (2·5 mm.). Forehead short and broad, subtriangular; anterior antennæ twice as long as the body, very slender beyond the middle, plentifully provided with very long setæ (fig. 1). Posterior antennæ (fig. 2) very long and slender, secondary branch very small, six-jointed, reaching to the end of the second joint of the larger branch; the small intercalated joints very indistinct, four or five in number. The five pairs of swimming feet all nearly alike; inner branches only about one-half as long as the outer. Abdomen short, about one-fifth of the length of the body; caudal stylets twice or thrice as long as broad; setæ five, nearly equal, not longer than the abdomen. Branches of the mandible-palp (fig. 3) slender, the outer branch two-, the inner one-jointed.

Habitat.—South Pacific, lat. 40° 3′ S., long. 132° 58′ W. (Station 288), and North Atlantic in lat. 26° 21′N., long. 33° 37′ W., taken in the tow-net down to 80 fathoms (Station 353). The last-named locality, it will be seen, is almost in the same latitude, and may be supposed to afford pretty much the same external conditions, as the Sicilian Station, at which the same species was found by Dr. Claus. The specimen figured in our plate, though imperfect, is drawn accurately from one of the two found in the above-mentioned gathering.[1]

[1] Except as to the jointing of the posterior antennæ, which was taken from a Pacific specimen.

2. *Hemicalanus orientalis*, n. sp. (Pl. IX. figs. 8, 9, and Pl. X. figs. 1–4).

Anterior antennæ (Pl. X. fig. 1) as long as the body, slender, and rather densely clothed with long setæ. The rostrum is long and slender, and the swimming feet much more robust than in the preceding species. One specimen only was found. Length, 1-9th of an inch (2·8 mm.). *Male* unknown.

Habitat.—Between Arrou and Banda.

3. *Hemicalanus aculeatus*, n. sp. (Pl. XLVI. figs. 2–4).

Length, 23-100ths of an inch (5·75 mm.). Forehead produced and sharply aculeated, body subcylindrical, cephalothorax six or seven times as long as the united lengths of abdomen and furca. Anterior antennæ longer than the body, twenty-five-jointed, basal joints short and clothed with plumose hairs, distal joints much more slender and bearing non-plumose setæ. Secondary branch of the posterior antenna long, six-jointed, and bearing very long plumose hairs, those of the primary branch non-plumose. Four pairs of swimming feet, which have all the branches three-jointed, the outer branches of all except the first pair bearing beautifully plumose setæ. Abdominal segments, except the first, extremely short; caudal lamellæ subquadrate, not much longer than broad and slightly divergent; setæ five, the outer about half as long as the inner, all densely plumose, the longest about twice the length of the abdomen. The proximal halves of the setæ throughout the body are usually either destitute of plumes or have them only slightly developed; colour of the plumes smoky brown.

I have seen only one specimen of *Hemicalanus aculeatus*, which was mounted during the cruise and labelled "Deep haul, 23rd July 1875, Pacific." The drawing of the whole animal given in Pl. XLVI. was taken from the mounting, and shows all that I could make out of the details before dissection.

Pleuromma, Claus.

Pleuromma, Claus, Die frei lebenden Copepoden, 1863.
Metridia, Boeck, Oversigt af Norges Marine Copepoder (1864).
,, Brady, Monog. British Copepoda, 1878.

Head distinct from the thorax; fourth and fifth segments of the thorax coalescent; abdomen composed in the male of five, in the female of three segments. Anterior antennæ twenty-five-jointed in the female, that of the left side in the male twenty-three-jointed,[1] that of the right side nineteen-jointed and geniculated between the

[1] In some cases the eighth and ninth articulations of the left antennæ are distinctly marked, and this condition is shown in the plate.

fifteenth and sixteenth joints; posterior antennæ and mouth-organs as in *Calanus*. First pair of feet much smaller than the rest; both branches of the first four pairs three-jointed; fifth pair composed of one branch only, prehensile in the male. A black, spherical eye spot, covered with a highly refracting lens, is situated on the side of the body, near the base of one of the foot-jaws.

Amongst other characters of his genus *Pleuromma*, Dr. Claus states that the head and thorax are coalescent, and that the inner branch of the first pair of swimming feet is composed of only two joints. Boeck, therefore, relying upon the distinctly separated head and thorax, upon the three-jointed inner branch of the first foot, and upon the absence of a pleural eye, necessarily assigned his new species *Metridia armata* to a distinct genus. But, while hesitating to disagree with so accurate an observer as Dr. Claus, I am bound to say that I believe his definition of *Pleuromma* to be founded—so far as regards the fusion of the head and thorax, and the jointing of the first pair of feet—on mistaken observation, or, it may be, on data derived from immature specimens. On the other hand, specimens of *Pleuromma* may frequently be found in which no lateral eye is visible (at any rate in spirit specimens), while the inconstant position of this organ, sometimes on the right side and sometimes on the left, seems to sanction the supposition that it is to some extent an extraneous appendage. I therefore think, taking one consideration with another, that there is no sufficient reason to maintain the separation of the two genera, and though doubtless *Pleuromma* is a misnomer when applied to species having no pleural eye[1], it must be adopted on the ground of priority.

Pleuromma abdominale, Claus (Pl. XI. figs. 1–13, and Pl. XII. figs. 1–16, and Pl. XXXI. figs. 13, 14).

Pleuromma abdominale, Claus, Die frei lebenden Copepoden, p. 195, pl. v. figs. 1–6, 13, 14, pl. vi. figs. 1–10.

Diaptomus abdominalis, Lubbock, Trans. Entom. Soc., vol. iv. (1856), p. 22, pl. x. figs. 1–8.

(?) *Pleuromma gracile*, Claus, Die frei lebenden Copepoden, p. 197, pl. v. figs. 7–11.

Length, 1-8th of an inch (3 mm.). Cephalothorax elongated, moderately robust; anterior antennæ twenty-five-jointed, about as long as the body, towards the base densely clothed with rather short setæ, interspersed with others of moderate length; the second and third joints in the *female* each armed with a sharp, recurved marginal spine, the following six or eight joints doubly denticulated (Pl. XI. fig. 2). The right anterior antenna of the *male* (fig. 4) has a strongly denticulated plate (fig. 5) on the proximal side of the hinge-joint, the sixth joint is imperfectly divided into three, and the tenth, eleventh, and fourteenth, are angularly dilated at the apices. The inner branch of the second pair of feet, on the left side only in the *male* (fig. 6), but on both sides in the *female*, has

[1] In the northern species, *Metridia* (*Pleuromma*) *armata*, there is no pleural eye.

its first joint deeply excavated at the base, the lower border of the sinus forming at its outer angle a strong curved spine. The outer branch of the third pair of feet in both sexes has the basal joint produced externally into a stout thumb-like prominence (fig. 7), and the two following joints have deeply sinuated margins, bordered with chitinous plates. The fifth pair of feet in the *male* (fig. 8) is strongly prehensile, each branch ending in a broad, clumsy, claw-like joint. In the *female* (fig. 10) each limb is simple, three-jointed, the last joint bearing three long, subequal apical setæ. The first segment of the *female* abdomen (fig. 1) is tumid, and equal in length to the two following segments; in the *male* (fig. 13) the abdominal somites are all of nearly equal length and shorter than broad, the last somite in both sexes dilated at the distal extremity and forming two angular lateral processes. The caudal laminæ are about twice as long as broad, the setæ subequal and rather shorter than the abdomen. In some adult *males* (fig. 12), the abdomen is distorted, bearing beard-like bunches of hairs or fimbriated marginal processes: in these specimens the caudal laminæ are also twisted and strongly setiferous. The pleural eye consists of a strongly pigmented ring, covered by a highly refracting lens, the whole appearing to be loosely attached just beneath the integument, and situated near the base of one of the foot-jaws. The vulva forms a prominent black, conical papilla on the front of the first abdominal somite.

The description given above applies to specimens which I believe to represent the completely developed adult form of the species :—these are figured in Pl. XI. A less fully developed form, which appears to me to belong to the same species, and which is undoubtedly identical with *Pleuromma gracile*, Claus, is shown in Pl. XII. and Pl. XXXI. figs. 13, 14. The chief points of difference are to be found in the length of the abdominal somites (figs. 14, 15), in the double hook of the first pair of feet (fig. 8), in the absence of the two hooked spines of the female antenna (Pl. XXXI. fig. 13), and in the want of a denticulated plate in the male antenna; the fifth pair of feet in the male (Pl. XII. figs. 10, 11) are of somewhat different shape, and in the female (fig. 12) have only two, instead of three, joints. In a still earlier stage of development (fig. 13), the branches of the female fifth foot end in three straight spines, like the prongs of a fork. A similar condition is shown in Pl. XI. fig. 11, drawn from specimens taken along with the adult form figured in the same plate. Fig. 9 in Pl. XI. represents what I believe to be an immature form of the fifth foot of the male. In some males of the immature form the antennæ bear numerous very largely developed sensory organs, club-shaped or pyriform (Pl. XII. fig. 2). These are sometimes so numerous and so closely packed that I at first doubted whether they were not parasitic growths; this, however, is certainly not the case. But the most important distinction between the normal form of the species and the *Pleuromma gracile* of Claus is that, in the former the *right* male antenna is the geniculated one, in *gracile* the *left*. This is a difference which I cannot yet satisfactorily explain. But considering the variable situation of the pleural eye, and the very fluctuating characters

of the species in some other respects; considering also that I have met with no gathering of the adult form in which the *gracile* form does not also occur, and that Dr. Claus likewise found both forms in the Mediterranean,—I yet adhere to the belief that a thorough study of the development and morphology of the animal will show these two debateable forms to be but varieties of one and the same species. It is perhaps worth noting that the only *females* which I have seen with attached spermatophores occurred in one or two gatherings containing *males* which had the distorted abdomen.

Habitat.—Lat. 47° 25′ S., long. 130° 12′ E.; off Port Jackson; off Cape Howe, Australia; off Kandavu, Fiji; off the Ki Islands; between Api and Cape York; Pacific, north of the Sandwich Islands; South Pacific, lat. 40° 3′ S., long. 132° 58′ W.; and off the west of Patagonia; lat. 36° 44′ S., long. 46° 16′ W.; lat. 37° 45′ S., long. 33° 0′ W.; Atlantic from lat. 5° N. to 2° N.; and about lat. 26° N., near Station 353; in lat. 36° 32′ S., long. 132° 52′ W. (Station 287); in lat. 64° 37′ S., long. 85° 49′ E. (Station 154); in lat. 37° 17′ S., long. 53° 52′ W. (Station 320).

Heterochæta, Claus.

Heterochæta, Claus, Die frei lebenden Copepoden, 1863.

Body attenuated behind, abdomen of the male five-, of the female four-jointed. Anterior antennæ twenty-five-jointed; that of the left side in the male feebly geniculated. Colouring matter of the eye entirely wanting. Posterior antennæ as in *Calanus*. Anterior branch of the maxilla obsolete. Anterior pair of foot-jaws very stout, armed with strong curved and partly pectinated setæ; posterior foot-jaws slender, nearly as in *Calanus*. Fifth pair of feet two-branched, those of the female like the preceding pairs, except that the outer branch bears a very long divaricate spine at the apex of its second joint; in the male the outer branches are prehensile and slightly different on the two sides. The left caudal stylet bears one excessively long seta.

Heterochæta, though abundantly distinct from any other described genus, presents some interesting points of resemblance, especially to *Candace*, *Leuckartia* and *Pleuromma*:—to *Candace* in the powerfully formed posterior foot-jaw, to *Leuckartia* and *Pleuromma* in the general build of the swimming feet and of the anterior antennæ. But the remarkably long seta of the left caudal segment, the absence of the internal branch of the maxilla, the characters of the fifth pair of feet in both sexes (which come nearer to *Centropages* than to any other genus), together with the very slightly deformed left anterior antenna of the male, constitute a sufficiently distinctive series of generic characters.

Heterochæta spinifrons, Claus (Pl. XIII. figs. 1–13).

Heterochæta spinifrons, Claus, Die frei lebenden Copepoden, p. 182, pl. xxxii. figs. 8, 9, 14, 16.

Length, one-sixth of an inch (4·2 mm.). Cephalothorax slender, tapering to each extremity (fig. 1), rostrum short, stout and bluntly pointed, not furcate. Anterior antennæ (figs. 1, 2) about as long as the body, slender; the base (in spirit specimens) thrown boldly forward from the front of the head, and then taking a sudden bend backwards; sparingly provided with very short marginal setæ, except near the base, where they are longer and more thickly set; apical joint rather short, its terminal setæ[1] not much longer than those of the other joints; in the *male* (fig. 3) the hinge joint forms a scarcely perceptible indentation, and there are no marginal spines or serratures. The inner branch of the posterior antenna (fig. 4) has four (? three) small median joints, and is nearly equal in size to the outer branch. The mandible (fig. 5) has four curved apical teeth, the two central teeth bi- or tri-furcate, the outermost tooth is, as it were, soldered to the side of the basal plate, its base forming a rectangular projection, and between it and the other teeth there is a wide gap. The maxilla (fig. 6) is long and slender, digitiform, has five or six stout apical setæ, a quadrate basal plate, which is marginally setose, and only one short tri-setose branch. The marginal setæ of the anterior foot-jaws (fig. 7) are very strong, and the last two are closely pectinated with short fine setæ on their inner margins; at the apex of the limb is a tuft of about six slender setæ, about half as long as the larger claws. The posterior foot-jaws (fig. 8) are like those of *Calanus*, but the basal joint bears one short spine, and an excessively long and strong flexuous seta. All the branches of the swimming feet, both external and internal, are three-jointed, the marginal spines are short, sharp and slender; the outer branch of the third pair (fig. 9) is, however, much dilated, and has a series of very short claw-like terminal spines. The fifth pair in the *male* (fig. 10) are only slightly different on the two sides; the inner branches are two-jointed, ending in a brush of six stout plumose setæ; the outer branches end in long, slender claws, that of the right side having two large digitiform processes on the inner margins of the first and third joints; in the *female* the fifth pair are alike on both sides (fig. 11), and differ little from the first and second pairs, except that the median joint of each outer branch bears on its inner margin a strong divaricate and slightly curved spine, which is as long as the third joint, and in the natural position of the limb crosses its fellow of the opposite side. The first abdominal somite in the impregnated *female* (fig. 12) is very large and tumid, the *receptaculum seminis* (?) forming a large rounded prominence on its anterior aspect; in the *male* the abdominal joints are nearly equal in size. The caudal stylets are about

[1] These setæ are scarcely long enough in the plate, and in fig. 1 the number of antennal joints is given incorrectly. The figure (10) illustrating the fifth pair of feet of the male, though representing rightly the specimen from which it was drawn, differs considerably from the same organs in other examples; probably, however, the discrepancies are characteristic of the various ages of the specimens.

twice as long as broad—as long as the two preceding abdominal segments of the *female*—and bear five setæ, which are shorter than the abdomen, except the fourth (counting from the outside) of the left stylet, which is about twice as long as the whole body of the animal. The spermatophores (fig. 12) are very large, and are attached singly; the contained spermatozoids (fig. 13) are also of unusual magnitude.

Habitat.—Torres Straits (Station 185); lat. 40° 3′ S., long. 132° 58′ W. (Station 288); lat. 36° 44′ S., long. 46° 16′ W., 2650 fathoms (Station 325); lat. 37° 45′ S., long. 33° 0′ W. (Station 330); lat. 7° 33′ N., long. 15° 16′ W. (Station 350); lat. 26° 21′ N., long. 33° 37W′. (Station 353); lat. 46° 46′ S., long. 45° 31′ E. (Station 146); lat. 37° 17′ S., long. 53° 52′ W., 600 fathoms (Station 320).

Though occurring in several very widely separated localities, this species seems to be nowhere abundant, not more than three or four specimens having been detected in any one gathering. All these are, as I think, referable to the same species, but I am not quite certain that they can be identified absolutely with either of the two forms described by Dr. Claus. As to *Heterochæta spinifrons*, that author lays especial stress upon the length of the anterior antennæ:—"die vordern Antennen beträchtlich länger als der Körper,"—whereas in our specimens the antennæ are very little, if at all, longer than the body. Again, in *Heterochæta papilligera* the posterior foot-jaws are stated to have only one spine:—"am Basalgliede des untern Maxillarfusses fehlt der obere Dorn,"—which is conclusive against its agreement with the Challenger specimens. On the whole, though with some doubt, it seems best to accept for the present the specific name *spinifrons*. None of the specimens which I have examined present the peculiarities ascribed to *Heterochæta papilligera*.

Leuckartia, Claus.

Leuckartia, Claus, Die frei lebenden Copepoden, 1863.

In general form like *Heterochæta*. Anterior antennæ serrated, twenty-five-jointed; that of the left side in the male geniculated, the five joints preceding the hinge slightly swollen. Posterior antennæ and mouth organs similar to those of *Calanus*. Fifth pair of feet two-branched, that of the right side having the outer branch strongly clawed. Both branches of the first four pairs of feet three-jointed. Each caudal stylet provided with one excessively long and several short setæ. Eye altogether wanting.

I cannot speak from my own knowledge as to the existence or non-existence of an eye. The passage in the foregoing definition which refers to this matter is taken from Claus.

1. (?) *Leuckartia flavicornis*, Claus (Pl. XV. figs. 1–9, 16).

Leuckartia flavicornis, Claus, Die frei lebenden Copepoden, p. 183, pl. xxxii. figs. 1–7.

Length, 1-4th of an inch (6·2 mm.). Body elongated; anterior antennæ slender, about as long as the body, moderately setiferous; those of the *male* plentifully provided

with club-shaped, sensory filaments (fig. 2). The inner branches of the first four pairs of feet are very short and three-jointed (fig. 6), the terminal spines of the outer branches are of moderate breadth, sword-shaped, and very minutely serrated on the inner edge (fig. 7). The fifth pair of feet in the *male* (figs. 8, 9) have on both sides a stout, two-jointed stalk, the terminal branches being three-jointed in the left foot, and two-jointed in the right; the second joint of the peduncle on the left side has the inner margin produced into a large five-toothed quadrate lamina, that of the right side is also slightly produced, and bears three small hairs; the outer branch of the left foot is twice as long as the inner, and is unarmed except with one or two minute apical setæ; on the right side the two joints of the outer branch form a powerfully prehensile but blunt, clumsily shaped claw; the inner branch short, with an ovate terminal joint which bears four setæ at its apex. The first and fourth segments of the *female* abdomen (fig. 1) are much longer and broader than the two intermediate segments, caudal stylets long, at least four times as long as broad, each bearing a single marginal seta of moderate length, and four terminal setæ, one of which is about as long as the body of the animal. Abdomen of the *male* (fig. 10) five-jointed.

Habitat.—Off Port Jackson, Australia; off Kandavu, Fiji; lat. 30° 44′ S., long. 44° 17′ W.; North Atlantic in several stations from lat. 7° 33′ N., long. 15° 16′ W., to lat. 26° 21′ N., long. 33° 37′ W. (Stations 350–353); in lat. 47° 25′ S., long. 130° 32′ E. (Station 159); and lat. 40° 3′ S., long. 132° 58′ W. (Station 288).

Very few specimens of *Leuckartia* were detected, and those mostly in imperfect preservation. On this account I have been unable to figure or describe the species as fully or minutely as I should have wished. I do not, however, find any noteworthy difference between the Challenger specimens and those described by Dr. Claus, except the size. Claus says "1¾—2 mm. long." The measurement of my figured specimen is over 6 mm., and I am not aware that it was larger than the very few others which came under my notice.

2. *Leuckartia* (?) *scopularis*, n. sp. (Pl. XIV. figs. 1–5).

This species I know only from two or three imperfect specimens which were found amongst surface animals taken between Japan and Honolulu. The peculiar brush-like cushion of hairs attached to the inner side of the bases of the fifth pair of feet of the *male*, afford what appears to be a sufficient specific character (figs. 3, 4), and though the foot of the left side was imperfect in the only *male* specimen, that of the right side certainly does not agree with *Leuckartia flavicornis*. The anterior antennæ are twenty-five-jointed, and that of the left side is simply geniculated (fig. 2); the caudal stylets (fig. 5) long and unequal, the tail setæ shorter than the abdomen, and nearly equal, except that one on each side is about half as long again as the rest. The animal itself was not measured, nor

were many of its parts so carefully observed as they ought to have been, as at the time I did not suspect that I should not be able to lay my hands on another specimen. The whole gathering, however, which is remarkably poor in Copepoda, has been hunted over without success, for further examples. The length of the anterior antenna is half an inch (12·75 mm.), and is probably about the same as that of the body of the animal.

Undina, Dana.

Undina, Dana, Proc. Amer. Acad. Sci., 1849 (not *Undina* of Claus).

Head anchylosed with the first thoracic segment. Anterior antennæ twenty-five-jointed in the female; those of the male alike on both sides, twenty-two to twenty-four-jointed, not geniculated, but distinctly angulated at the sixth or eighth joint. Both branches of the posterior antennæ equal in length, secondary branch four-jointed, the two median joints very short and indistinct. Mandible broad, numerously toothed, palp with a large quadrate base and two short bi-articulate branches, the first joint of the inner branch swollen and almost circular. Maxilla-palp well developed, the lower branch digitiform, three-jointed, the upper smaller and crescentic. Anterior and posterior foot-jaws as in *Calanus*. Five pairs of feet in both sexes, both branches three-jointed; fifth pair in the male on the right side very largely developed and prehensile, on the left small and not much different from the preceding pairs. Abdomen of the male five-, of the female four-jointed.

The angulated male antenna, the three-jointed inner branches of all the swimming feet, the absence of excessively long antennal and caudal setæ, the prehensile form of only one of the fifth feet in the male, and the presence of five pairs of feet in the female, are the characters which distinguish *Undina* from the very closely allied genus *Euchæta*. From *Scolecithrix* it is separated by the larger number of joints in the anterior antenna, the equality of the two branches of the posterior antenna, the uniformly three-jointed inner branches of the swimming feet, and the presence of a normally formed fifth pair in the female, while *Scolecithrix* is still further distinguished by the peculiarity from which it takes its name—the presence of a fascicle of worm-like filaments at the apex of the posterior foot-jaw. Both the species here described have a very wide range of distribution, being found abundantly over almost the whole areas of the Pacific and Indian Oceans, and over a large part, at any rate, of the Atlantic. *Undina messinensis*, Claus, and *Undina danæ*, Lubbock, present some peculiarities of structure which have led me to place them under a distinct genus (*Scolecithrix*), and *Undina pulchra*, Lubbock, seems properly to belong to *Euchæta*.

1. *Undina vulgaris*, Dana (Pl. XV. figs. 11–15; and Pl. XVIII. fig. 6).

Undina vulgaris, Dana, Crustacea of U. S. Expl. Exped. (1852), p. 1092, pl. lxxvii. fig. 8, *a–d.*
(?) *Undina simplex*, idem, ibidem, p. 1094, pl. lxxvii. fig. 9, *a–b.*
Undina inornata, idem, ibidem, p. 1095, pl. lxxvii. fig. 11, *a–d.*
Undina longipes, Lubbock, On some Entomostraca collected by Dr. Sutherland, Trans. Entom. Soc., 1856, p. 17, pl. vi. figs. 1–5.

Length, 1-8th of an inch (3·1 mm.). Cephalothorax elongated, cylindrical, rounded in front; as seen from the side (Pl. XVIII. fig. 6); the posterior ventral angle is produced usually into two short divergent spines; seen from behind the angles of the cephalothorax are sub-acute and slightly produced downwards. Rostrum moderately long and furcate. Anterior antennæ (Pl. XV. figs. 11, 12) twenty-five-jointed in the *female*, twenty-four-jointed in the *male*, not much longer than the cephalothorax, fringed with short setæ, with at distant intervals—notably on the second or third, eighth and seventeenth joints—one considerably longer than the rest; the last joint in the *female* has three or four short apical setæ, the last but one has two, and the penultimate one, long apical seta; the antenna of the *male* is angulated at the eighth joint. The second swimming foot in both sexes (fig. 13) has the second joint of the outer branch deeply indented at the base, and produced downwards into a strong spine, the whole external margin having thus a somewhat hatchet-shaped outline; the terminal spines of the swimming feet are slender, with finely serrated outer margin and bent tip. In the *male*, the fifth pair of feet (fig. 14) are dissimilar on the two sides, that of the right side excessively long, and when extended reaching beyond the extremity of the tail; the two basal joints are long and slender, the third much shorter and giving attachment at its apex to a very long attenuated and irregularly flexed claw, and to an irregularly quadrate appendage from which spring a long falcate claw, and a curiously contorted two or three-jointed and flaccid process; the foot of the left side is two-branched, the inner branch extremely small, three-jointed and simple, the outer somewhat larger, fashioned in the normal manner but devoid of setæ, and bearing at the apex of the second joint a minute subulate process. The caudal segments (fig. 15) are about as broad as long, and equal in length to the last abdominal segment; the setæ much shorter than the abdomen, except the fourth (counting from the outside), which is much stouter than, and about twice as long as, the rest.

Sir John Lubbock's measurement is 1-10th of an inch, Dana's 1-12th of an inch.

Habitat.—Off Cape Howe and Port Jackson, Australia; between Sydney and Wellington; between Api and Cape York; between Arrou and Banda; in very many places amongst the Philippine Islands; off New Guinea and North Australia; in the Pacific north of the Sandwich Islands; at Zamboanga, in the Arafura Sea; off Kandavu, Fiji; and in all the gatherings that I have examined from the tropical Atlantic, ranging between lat. 10° S., and lat. 25° N.

In some gatherings the species was extremely abundant, more especially in those taken off South Australia and in the tropical Atlantic; and the red colour (brick-red) mentioned by Dana was distinctly observed in some samples, even after their prolonged immersion in spirit. These specimens are undoubtedly identical with those described by Sir John Lubbock as *Undina longipes*, and though Dana's figures are too small and his detailed descriptions too meagre for absolute certainty, I can scarcely doubt that they are meant to refer to this species: it would be strange if so widely spread and so abundant a species had escaped him, and if so that his species—likewise widely spread—should have also eluded the Challenger. Dana's drawing of the fifth foot of the male—the only characteristic detail which he gives—applies fairly well to our specimens, if we allow for the absence of minutiæ, consequent, perhaps, on the use of too low microscopic powers; and I cannot recognise any distinction between the examples described by the same author under the three specific names, *vulgaris*, *simplex* and *inornata*.

One unmistakeable diagnostic mark of *Undina longipes* is the peculiar emargination of the second foot in both sexes—a mark quite sufficient for specific determination, even when no males may be present. The bidentate postero-ventral angle of the thorax, though perhaps not always present, is, I believe, another good specific character.

2. *Undina darwinii*, Lubbock (Pl. XVI. figs. 1–4, 6–14).

Undina darwinii, Lubbock, On some Oceanic Entomostraca collected by Captain Toynbee, Trans. Linn. Soc., vol. xxiii. p. 179, pl. xxix. figs. 4, 5.

Cephalothorax rounded off in front and behind, posterior ventral angle slightly exserted. Anterior antennæ of the *female* (figs. 3 and 4) twenty-five-jointed, the joints not varying much in length, except that the second is much larger than the rest; in the *male* (fig. 2) the antenna is twenty-two-jointed, angulated at the sixth joint, the first two joints long, equalling the following three or four joints; in both sexes the anterior antennæ are slightly longer than the cephalothorax, and clothed with marginal hairs which are very short except at the apex; the second and sixth joints, in the *male*, each bear a single long seta. The posterior antennæ have the two branches nearly equal in size the inner branch four-jointed, with two small and rather indistinct median joints.[1] Mandibles broad at the apex (fig. 6), numerously and sharply toothed; basal joint of the palp very large, first joint of the inner branch swollen, both branches short and bi-articulate. Maxilla (fig. 7) well-developed, anterior foot-jaw small (fig. 8), posterior (fig. 9) well developed. The outer branches of the swimming feet are more or less strongly serrated between the last two marginal spines; the

[1] Fig. *b* pl. xvi. belongs to another species, and has been inadvertently included among the figures of *Undina darwinii*.

first joint of the base in the third pair (fig. 10) has three small spines on the outer and a crescent-shaped row of six or eight similar spines towards the inner margin; the fourth pair is similarly armed as to the inner, but not as to the outer margin; the terminal spines of the feet are bent at the tips, as in *Undina vulgaris*, but are scarcely so slender, and the margins are not distinctly serrated. The right foot of the fifth pair in the *male* (fig. 11), is excessively long, the first two joints being nearly as long as the abdomen, and the extremity of the organ reaching as far as the very apices of the longest tail-setæ; the first basal joint—as also that of the left foot—has a serrated inner margin; the second joint gives attachment to a rudimentary, wedge-shaped inner branch, the smooth joint of the prehensile branch is produced externally into a very long slender and tortuous, immobile claw, which near the middle bears a small hook-like marginal process; the third joint is simple but has attached at its apex a large moveable appendix, shaped roughly like the letter E. The fifth foot of the *female* also has its first basal joint marginally serrated. The foot of the left side (fig. 12) is small, but otherwise does not much differ from the ordinary swimming feet, except in the absence of setæ on the outer branch. The *female* abdomen (fig. 14) has the distal borders of the first two joints more or less completely fringed with short setæ. The caudal stylets are as broad as long, and equal in length to the last abdominal segment; the fourth caudal seta is longer, and in the *female* much stouter than the rest—about once and a-half the length of the abdomen.

Length of the *female*, 1-10th of an inch (2·55 mm.), of the *male*, 1-12th of an inch (2·1 mm.).

Habitat.—Off Port Jackson, Australia; between Sydney and Wellington; between Api and Cape York; between Arrou and Banda; off the north of Papua; in several stations amongst the Philippine Islands; Pacific, north of the Sandwich Islands; lat. 36° 32′ S., long. 132° 52′ W. (Station 287); lat. 42° 43′ S., long. 82° 11′ W. (Station 302); lat. 36° 44′ S., long. 46° 16′ W. (Station 325); lat. 26° 21′ N., long. 33° 37′ W. (Station 353).

This is certainly one of the most remarkable as well as one of the most common of southern pelagic Entomostraca. Though not occurring amongst the Challenger gatherings quite so commonly as *Undina vulgaris*, its distribution seems to be pretty much the same, and in some of the bottles it was found very abundantly. The male is easily recognised, even with a simple hand lens, by the extraordinary length and grotesque form of the fifth foot. In all essential structural characters it agrees with the type-species, *Undina vulgaris*, and I have given drawings of its various parts as illustrating the generic characters. The amount of ciliation of the female abdominal segments, and the apical pectination of the swimming feet vary very much in different examples. The immensely long fifth foot of the male would appear to be used partly to convey spermatophores to the vulva of the female. I have never actually seen these bodies attached to the limb (as is frequently observed in *Euchæta*), but it is difficult to account in any other

way for the frequent occurrence of spermatophores glued to the back of the female, usually on the penultimate thoracic ring. This I have seen so often, that I came to recognise the females of the species, under the hand lens, by that character alone. It is obvious that the fixture of a spermatophore in that situation must be an entirely futile proceeding, but it is equally evident, from the abundance of the species, that plenty of spermatophores must get properly located. The males of *Undina darwinii* are extremely abundant, and must, if we take as a law the proportions of the sexes amongst other Copepoda, and especially amongst the species of the nearly allied genus *Euchæta*—be far more than sufficient for the impregnation of the females. The competition for females will thus be very severe, and in the heat of the chase it seems very possible that miscarriages of the kind referred to may often happen. If this explanation be fanciful or wide of the mark, the fact of the common malposition of the spermatophores is, at any rate, an interesting one.

Scolecithrix,[1] n. gen.

Undina, Lubbock (in part) Trans. Entom. Soc., 1856.
(?) *Undina*, Claus, Die frei lebenden Copepoden, 1863.

Head and thorax coalescent, rostrum short and furcate, posterior ventral angle of cephalothorax somewhat produced. Anterior antennæ in the female twenty to twenty-three-jointed, in the male nineteen-jointed, not geniculated. Mandibles well developed. Inner branch of the maxilla very small. Inner (secondary) branch of the posterior antenna longer than the outer, its first joint imperfectly divided near the base, two small joints intercalated between it and the terminal joint. Anterior foot-jaw bearing at the apex, instead of the usual curved setæ, a bunch of thick flexuous (sensory ?) filaments. Posterior foot-jaws nearly as in *Calanus*. Inner branches of the first pair of feet one-, of the second two-jointed, of the third and fourth pairs three-jointed, the first joint in all cases very small. Fifth pair of feet in the female wanting or rudimentary, in the male elongated and prehensile. Abdomen in both sexes four-jointed; no long tail seta.

Claus states that the first pair of foot-jaws in the male *Undina messinensis* are obsolete. This is certainly not the case in the typical *Undinæ*, nor is it so in the species which I have here referred to the new genus *Scolecithrix*. If it be really so in *Undina messinensis*, another genus must be established for the reception of that species, unless, indeed, it be referable to *Euchæta*. Another important difference, noticed by Claus, is in the structure of the posterior antennæ, the outer branch of which is very much smaller than in any species of *Undina* or *Scolecithrix* known to me.

[1] σκώληξ, a worm; θρίξ, hair.

1. *Scolecithrix danæ*, Lubbock (Pl. XVII. figs. 1-12).

Undina danæ, Lubbock, On some Entomostraca collected by Capt. Sutherland, Trans. Entom. Soc., vol. iv. 1856, p. 15, pl. ix. figs. 6-9.

Cephalothorax robust (fig. 1), in the *female* usually not more than twice as long as broad, in the *male* somewhat more slender. Anterior antennæ (figs. 2, 3) about as long as the cephalothorax, in the *male* nineteen-jointed, strongly arcuate, but not angulated, in the *female* twenty-jointed; the first two joints in both sexes are stout and of moderate length; they are followed by five very short and equal joints; the seventh joint in the female, the eighth in the male, is equal in length to the preceding five, and in some cases is indistinctly divided into four; the remaining joints do not vary greatly in length, except that the last (in the female) is very minute. Mandibles (fig. 5) rather narrow at the apex, basal joint of the palp large, smaller branch two-jointed, larger indistinctly divided into several joints. Inner branch of the maxilla (fig. 6, *a*) very small, composed of one or two (?) minute setiferous digits. The anterior foot-jaw (fig. 7) has four stout marginal processes, armed, as usual, with strong plumose setæ, the terminal joints bearing about six thick fusiform filaments, which are about half as long as the marginal setæ, and are filled with granular protoplasm. Posterior foot-jaws well developed and formed like those of *Calanus*. Inner branches of the first pair of feet one-, of the second two-jointed, of the third and fourth pairs three-jointed, the first joint in all cases very small. Terminal spines of the swimming feet (fig. 8) strongly serrated on the outer and setose on the inner margin. Fifth pair in the *female* wanting, in the *male* (fig. 9) elongated, slender, that of the left side unbranched, the right bearing a simple one-jointed ienur branch, which opposes the clawed extremity of the outer branch. Abdomen in both sexes four-jointed, in the *male* slender, in the *female* (figs. 11, 12) short and stout, the first segment as large as the following three, tumid and prominent in front, where it is produced downwards, forming a pouch-like extension. Caudal segments distant, as broad as long, length about equal to that of the second or third abdominal somite; setæ sub-equal in length, not much exceeding that of the abdomen. Colour of the animal dark brown; length 1-11th of an inch (2·3 mm.).

The drawing of the female anterior antenna (fig. 3) is not quite accurate; no division should have been shown in the large first joint (though an imperfect one sometimes exists), and the last joint should have shown an extremely small segment at the apex. The large basal portion of the male antenna is, however, correctly given as divided into two.

Habitat.—Off Port Jackson, Australia; off Kandavu, Fiji; between Api and Cape York; between Arrou and Banda; at several stations amongst the Philippine Islands; off the east coast of Japan (Station 237); in lat. 32° 24′ S., long. 13° 5′ W. (Station 335); in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); in several Atlantic stations from lat. 3° 10′ N., long. 14° 51′ W. to lat. 26° 21′ N., long. 33° 37′ W. (Stations 348–353).

The stout build, and—in the female—the very short abdomen of this species are almost sufficient to distinguish it at a glance from any other. On closer examination the most conspicuous character is the remarkably long eighth joint of the anterior antenna in both sexes; the joint is evidently formed by the coalescence of four into one, traces of this composition being, in some cases, quite distinct. The peculiar club-shaped filaments of the anterior foot-jaw may perhaps be olfactory organs; they seem at any rate to resemble appendages which have been so considered in other Crustacea, and from their situation it seems most likely that they are in some way subsidiary to alimentation.

The occurrence of a four-segmented abdomen in both sexes is a little remarkable, and though Sir John Lubbock's observation agrees with my own in ascribing only four joints to the male abdomen, I was at first suspicious of a mistake. On careful re-examination, however, I have been unable to see more than four joints in either sex, but the fourth in the female is often so small as to be almost obsolete (see fig. 11). Sir John Lubbock describes the tail setæ as four in number, and in many cases I have not found more than that; but in others (and this I suppose to be the normal condition) there is a very slender fifth seta, attached, I think, between the third and fourth.

This species, though not perhaps so abundant as *Undina darwinii* or *Undina longipes*, is often found associated with them, and in very considerable numbers.

2. *Scolecithrix minor*, n. sp. (Pl. XVI. figs. 15–16, and Pl. XVIII. figs. 1–5).

Length, 1-15th of an inch (1·6 mm.). Cephalothorax moderately stout, broadly rounded in front, postero-ventral angle acute, dorsal rounded off. Anterior antenna in the *male* nineteen-jointed, angulated at the tenth joint, eighth joint very long, in the *female* twenty-three-jointed, the large basal joint showing a faint trace of another articulation. The mouth-organs are almost exactly like those of *Scolecithrix danæ*, but the maxilla (Pl. XVIII. fig. 3) is entirely destitute of an inner branch, and the anterior foot-jaws of the *male* (fig. 4) are much more sparingly setiferous. The feet of the fifth pair in both sexes are unbranched, in the *female* (Pl. XVI. fig. 16) minute, cylindrical, three-jointed, the last joint furcate at the apex; in the *male* (fig. 15) the right foot is longer than the left, the last joint slender and bayonet-shaped, the antepenultimate bearing a rather long lateral adpressed process; the left foot ends in a trifid (?) slender claw.

Habitat.—*Scolecithrix minor* was found only in a surface-net gathering from lat. 46° 46′ S., long. 45° 31′ E. (Station 146). In this bottle, however, it occurred in considerable abundance.

The comparatively small dimensions and apparently imperfect development of some of the parts of this animal led me to suspect that it might perhaps be only an immature form. But it can scarcely belong to *Scolecithrix danæ*—the only known Copepod which possesses similar mouth-organs—the fifth pair of male feet being distinctly different.

And I cannot suppose that the female would lose its fifth pair of feet in a more advanced stage of development, which must be the case if it be really a young *Scolecithrix danæ*. Moreover, had it belonged to that species it would almost certainly have been noticed in some of the many gatherings in which *Solecithrix danæ* occurred.

Euchæta, Philippi.

Euchæta, Philippi, Archiv. f. Naturgesch., 1843.
„ Dana, Proc. Amer. Acad. Sci., 1849.
„ Claus, Die frei lebend. Copep., 1863.
Euchirus, Dana, Amer. Journ. Sci.

Head and thorax coalescent. Anterior antennæ twenty-four-jointed, those of the female provided with a few very long setæ, those of the male scarcely geniculated and bearing much shorter setæ. Forehead elongated, triangular, rostrum transversely notched or simply curved, not furcate. Eyes small, simple. Mandibles well developed in the female, biting portion wanting in the male. Maxillæ abnormal, the two branches almost coalescent, in the male very minute. Anterior foot-jaws short and stout, strongly setiferous, obsolete or entirely wanting in the male. Posterior foot-jaws very long and well developed, doubly geniculated and conspicuously projected from the body, very small in the male. Inner branch of the first pair of swimming feet one- (or two-) jointed, of the second pair one-jointed, of the third and fourth pairs three-jointed. Fifth pair wanting in the female, in the male much elongated, both limbs prehensile. Abdomen in the female composed of four, in the male of four or five segments; tail setæ in the male nearly equal, the second seta of the female, on each side, usually very long.

The eyes were not seen except in one or two of the specimens, having been mostly obliterated by immersion in alcohol, but from an indistinct glimpse of them in these examples they seem to be very minute, and situated almost immediately behind the rostrum. The last very minute joint (twenty-fourth) of the anterior antenna (in *Euchæta prestandreæ*) is called by Claus a tubercle, but I am unable to see any structural distinction between it and the other joints. The absence of the biting segment of the male mandible is a very remarkable, and, so far as I know (with the single exception of *Calanoides*, a new genus described further on), a unique character amongst the Gnathostomata. It is not noticed by Claus or by any other author, but I have carefully dissected many specimens of *Euchæta prestandreæ* and other species, and have never been able to find a trace of that structure, except in the case of *Euchæta australis*, where there is a doubtful rudiment of it. The very feeble development of the male maxillæ and foot-jaws, together with the absence of the mandible, and sometimes also of the first foot-jaw, points perhaps to the conclusion that the life of the creature is a very short one, death possibly following speedily the act of copulation. We seem to have here a case of retrograde development,

differing only in degree from those well-known and more conspicuous examples found amongst the lower parasitic Copepoda and the Cirripedes.

I observed in several cases—and this is noticed also by Claus—the attachment of spermatophores to one of the fifth feet of the male (see Pl. XVIII. fig. 13, *a*). There can be little doubt, I suppose, that this is the mode in which the fertilising element is transferred to the generative system of the female; the spermatophores are quite commonly seen affixed to the vulva. I have not noticed the club-shaped sensory appendages of the anterior male antennæ which are figured and described by Claus, but though those organs are frequently present in the males of most Calanoid Copepoda, their number and size are extremely variable even in the same species. Indeed it seems to me very probable that they are subsidiary sexual organs, adapted for some temporary purpose, and, that purpose being fulfilled, that they—if the animal lives long enough—may drop off or become atrophied. On the other hand, those males which are without them are probably, in the majority of cases, individuals not yet arrived at sexual maturity.

The genus is very widely distributed, indeed almost ubiquitous, except perhaps in the Arctic and Antarctic, and in the colder parts of the temperate seas. The number of species, however, seems to be small, several of those described by Dana being, as I believe, founded upon different stages of growth of the same animal. The most conspicuous generic characters are, in the female, the very long, scattered setæ of the anterior antennæ, the absence of the fifth pair of feet, and the large doubly geniculated posterior foot-jaws; in the male, the long prehensile feet, the absence of the mandibles, and the absence or atrophy of the first pair of foot-jaws. I strongly suspect that the notched rostrum will be found to characterise one species only—*Euchæta prestandreæ*. At any rate the genus as here defined includes some species which have neither that character nor the single long caudal seta.

1. *Euchæta prestandreæ*, Philippi (Pl. XVIII. figs. 7–15 (male), and Pl. XIX.).

? *Euchæta prestandreæ*, Philippi, Archiv f. Naturgesch. (1843), Taf. iv. fig. 5.
„ „ Claus, Die frei lebenden Copepoden, p. 183, pl. v. fig. 12, *a*, pl. ix. figs. 6, 7, 9, 12, pl. xxx. figs. 8–17.
„ *communis*, Dana, Proc. Amer. Acad. Sci. (1849) and Crust. U. S. Expl. Exped., p. 1086, pl. lxxvii. fig. 1, *a–e*, and fig. 2, *a–e*.
? „ *concinna*, Dana, Crust. U. S. Expl. Exped., p. 1088, pl. lxxvii. fig. 4, *a–b*, and fig. 5, *a–c*.
? „ *pubescens*, Id. Ibid. p. 1090, pl. lxxvii. fig. 6, *a–g*.
„ *atlantica*, Lubbock, On some Entomostraca collected by Dr. Sutherland, Trans. Entom. Soc., vol. iv. 1856, p. 13, pl. viii.
„ *sutherlandii*, Id. Ibid. p. 14, pl. ix. figs. 1, 2.

Length, 1-8th to 1-5th of an inch (3–5 mm.). Rostrum transversely notched and forming two sharp teeth. Anterior antennæ of the *female* rather longer than

the cephalothorax, twenty-four-jointed, many of the joints laterally produced and angulated at the apices, the third, seventh, eighth, thirteenth, seventeenth, twentieth, and twenty-second joints each bearing a very long apical seta, equal in length to about one-third of the antenna; the twenty-third joint (penultimate) has two long and two or three shorter setæ, and in addition to the long setæ the intermediate joints have mostly one or more short ones. In the *male* the anterior antenna is slightly angulated at the twelfth joint (Pl. XVIII. fig. 8), thickly fringed with short setæ near the base, more sparingly beyond, and has likewise a few scattered longer setæ; these, however, are not nearly so long as in the *female;* the eighth and ninth joints are coalescent. The mandible in the *female* (Pl. XIX. fig. 4) is broad and strongly toothed at the apex, palp large, with a broad base and two short biarticulate branches: in the *male* (Pl. XVIII. fig. 9) there is no biting segment, and the palp is very small: the outer branch of the maxilla is obsolete (Pl. XIX. fig. 5, and Pl. XVIII. fig. 10), and the whole limb is in the *male* minute. The anterior foot-jaws are of moderate size in the *female*, but rudimentary in the *male*. Posterior foot-jaws very large in the *female* (Pl. XIX. fig. 7), with two long basal and five small apical joints, very small in the *male* (Pl. XVIII. fig. 12). The outer branches of all the swimming feet are three-jointed, except that of the first pair in the *female*, which is only two-jointed (Pl. XIX. fig. 8). The inner branches of the third and fourth pairs in both sexes are three-jointed. That of the first pair in the *female* has one joint only, in the *male* one (or sometimes two) joints. In both sexes the inner branch of the second pair has only one joint. The fifth pair of the *male* (Pl. XVIII. fig. 13) are of equal length, that of the left side simple, ending in a very long subulate joint, the basal joint bearing a rudimentary rod-shaped inner branch which is as long as the second joint; the terminal joint of the right foot has one long and slender apical spine and another much smaller one; it has also, springing from its inner margin, a stout appendage, which is dilated and toothed at the apex and fringed on the margin with minute hairs; in the axil between this and the main portion of the limb is a small conical ciliated process. (The immature fifth feet of *Euchæta sutherlandii*, Lubbock, are represented in fig. 14). The abdomen is sometimes slightly pubescent, the last segment in both sexes always very short, the second caudal seta of the *female* is extremely long, often longer than the whole body of the animal, the others variable in length but not longer than the abdomen. The two branches of the posterior antennæ (Pl. XIX. fig. 3) are nearly equal in length; the inner branch four-jointed, first and third joints very short, bearing three apical and four lateral setæ. The second pair of feet in both sexes (Pl. XIX. fig. 9) differs from the rest in having the spine-bearing angles elongated into small finger-like processes. The serratures of the terminal spines of all the feet are extremely delicate, about fifty or more on each spine. The external egg-masses are not enclosed in a definite sac, but are loosely aggregated like bunches of grapes.

Habitat.—Off Port Jackson, Australia; between Sydney and Wellington; off Kan-

davu, Fiji; between Api and Cape York; between Arrou and Banda; off the north and south coasts of Papua; Arafura Sea; lat. 46° 46′ S., long. 45° 31′ E. (Station 146); lat. 47° 25′ S., long. 130° 32′ E. (Station 159); in several places amongst the Philippine Islands; between Japan and Honolulu; Pacific, north of the Sandwich Islands; lat. 42° 43′ S., long 82° 11′ W. (Station 302); lat. 36° 44′ S., long. 46° 16′ W. (Station 325); lat. 37° 45′ S., long. 33° 0′ W. (Station 330); in many gatherings from the tropical Atlantic between lat. 12° 16′ S., long. 13° 44′ W. (Station 341) and lat. 32° 41′ N., long. 36° 6′ W. (Station 354).

If the Challenger collections may be taken as a fair indication, this would seem to be the most abundant and most widely distributed of all the pelagic Copepoda.

At the same time the possibility must be admitted of more than one species being included in the series which I here refer to *Euchæta communis*. In very many gatherings, though females were abundant no males could be found, and on the characters of the latter sex perhaps some specific distinctions might have been based. As to the females, I have not found any variations which appeared to me of specific value. The form of the male described by Sir John Lubbock as *Euchæta sutherlandii*, occurs not uncommonly, and I do not doubt is simply the immature male of *Euchæta prestandreæ;* this view is also taken by Dr. Claus. And though it is difficult to decide the point absolutely from Dana's drawings and descriptions, I believe that the same remark applies to his *Euchæta concinna*. Nor do I find any sufficient marks to warrant the separation of *Euchæta pubescens:* the characters given as belonging to this last species I have found not unfrequently in what I take to be mere varieties of *Euchæta prestandreæ*. It would indeed be wonderful if a species so widely distributed did not present many varieties dependent upon race and external conditions.

If I am right in regarding all *Euchætæ* with a notched rostrum and a single elongated tail seta as belonging to one species, we may fairly identify it with that described by Philippi as *Euchæta prestandreæ;* but no other characters of specific value are noticed by that author. Dr. Claus, at any rate, has referred to *Euchæta prestandreæ*, the Mediterranean species figured in his work, which is undoubtedly also identical with Lubbock's *Euchæta atlantica*. There is more doubt about the reference to Dana's *Euchæta communis*, though there is nothing in the figures or descriptions, except insufficiency of detail, to discredit that reference. It is scarcely possible that a species so common and widely distributed as that now under discussion should have been missed by Dana: and a more appropriate term than *communis* could hardly have been applied to it, but if, as appears likely, Philippi's name referred to the same species, it has the claim of priority in date.

2. *Euchæta hessei*, n. sp. (Pl. XX. figs. 1–13, and Pl. XXIII. figs. 11–14).

Anterior antennæ nearly as long as the body, twenty-three-jointed in the *male*, twenty-four-jointed in the *female*, the last joint half as long as the preceding one, provided with long setæ at the apices of the third, seventh, eighth, thirteenth, twenty-third, and twenty-fourth joints, and with very short setæ on the intermediate joints; rostrum long and simply curved; in the *female* there is a very small terminal joint, but this is wanting in the *male*, its place being supplied by a few setæ and a pyriform sensory appendage. Posterior antennæ (Pl. XX. fig. 3) as in *Euchæta prestandreæ;* those of the *female* more densely setose than in the *male*. Mandibles and anterior foot-jaws (figs. 4, 8, 9) as in *Euchæta prestandreæ*. External branch of the maxilla-palp in the *female* (fig. 5 *a*) rudimentary, inner branch (*b*) elongated, digitiform; in the *male* (fig. 6), the maxilla is very small, the biting portion altogether wanting. The anterior foot-jaw is wanting in the *male*, but in the *female* (fig. 7), has the innermost seta of each digit pectinated near the base with a row of short rigid setæ, the rest of the setæ simply plumose: the last seta of the second joint of the posterior foot-jaw bears also a marginal comb-like row of cilia. The structure of the swimming feet is exactly as in *Euchæta prestandreæ*, except as to the terminal spines (fig. 10), which are much more strongly serrated, the number of serratures being from twenty to twenty-two on each spine. The basal joints of the fourth pair of feet in the *female* (fig. 10, *a*) are armed on their internal margins with a comb-like row of about five very broad and strong spines. The fifth pair of feet of the *male* (fig. 11) does not possess any toothed appendage, but in other respects is much like that of the preceding species. The abdomen in both sexes is four-jointed, but much shorter and stouter in the female (figs. 12, 13). Caudal stylets about as long as broad; setæ nearly equal in both sexes, scarcely longer than the abdomen. Length, 1-8th of an inch (3·1 mm.). The two specimens taken between Japan and Honolulu were twice this length.

Habitat.—This species was found in a gathering from lat. 38° 7′ S., long. 94° 4′ W. (November 6th, 1875, near Station 295). The captures of Copepoda in this Station consisted almost entirely of two species in about equal numbers:—*Euchæta hessei* and *Calanus valgus*. It occurred also amongst surface animals from lat. 36° 32 S., long. 132° 52′ W. (Station 287). Two specimens were found in a surface gathering made between Japan and Honolulu, and a few at Station 352, lat. 10° 55′ N., long. 17° 46′ W.; between Api and Cape York; and at a Station near the Philippine Islands (January 9th, 1875).

3. *Euchæta pulchra* (Lubbock), (Pl. XIV. figs. 6–9, Pl. XX. figs. 14–19).

Undina pulchra, Lubbock, On some Entomostraca collected by Dr. Sutherland, Trans. Entom. Soc., vol. iv., 1856, pl. iv. figs. 5–8, and pl. vii. fig. 6.

Length, 1-6th of an inch (4·2 mm.). Cephalothorax robust, rounded in front, obtusely angulated behind, rostrum short, simply curved. Anterior antennæ as long

as the body, twenty-four-jointed, very sparingly provided with long setæ. Posterior antennæ, mandibles, maxillæ, foot-jaws, and swimming feet as in the preceding species. Terminal spines of the swimming feet strongly serrated, very similar to those of *Euchæta hessei*. Fifth pair of feet of the *male* (fig. 17) elongated, that of the left side simple, slender, not clawed; on the right side ending in two very long, slender, opposable claws, one of which is armed with a series of small marginal tooth-like tubercles, the other with several larger angulated protuberances. The abdomen of the *male* is four-jointed, of the *female* three-jointed, the first joint having a hook-like process on the dorsal surface. Caudal segments very short, setæ stout, subequal, about as long as the abdomen, and densely plumose.

Habitat.—Taken in the North Atlantic at night, near Station 353, May 7, 1876, about lat. 27° N., long. 33° W. Though many specimens of *Euchæta pulchra* occurred in this gathering, I have not seen it in any other, and this is, I think, the only instance amongst the Challenger collections in which the night captures have yielded any peculiar species. Amongst the Copepoda there does not, indeed, appear to be so great a difference between nocturnal and diurnal species as there is amongst some other tribes of pelagic Crustacea.

4. *Euchæta* (?) *philippii*, n. sp. (Pl. XXI. figs. 1–4).

Female (?)—Length, 1-4th of an inch (6·2 mm.). Cephalothorax robust, broad in proportion to the length. Anterior antennæ (fig. 2) about as long as the cephalothorax, twenty-five-jointed, second joint much larger than the rest, which are not very unequal in length, the whole limb profusely clothed with more or less adpressed hairs, those of the last eight joints longer than the others. The chief terminal spines of the swimming feet (fig. 3) are very coarsely serrated, having only about twelve serrations; the larger of the secondary spines unusually well developed, at least half as long as the principal spine, and densely ciliated. There is a rudimentary fifth pair of feet (fig. 4), extremely small, and composed of two obtuse, cylindrical branches.

Habitat.—A very few specimens only were noticed amongst the captures from lat. 36° 44′ S., long. 46° 16′ W., depth 2650 fathoms (Station 325), and a few, probably referable to the same species, from Station 288 (lat 40° 3′ S., long 132° 58′ W.). This species is only provisionally assigned to the genus *Euchæta*. The mouth-organs—mandibles and foot-jaws—are exactly those of the normal female *Euchæta*, but the presence of a fifth pair of feet, though very small, is abnormal. If a male this specimen certainly cannot be rightly referred to *Euchæta*, inasmuch as the mandibles, maxillæ, and foot-jaws are fully developed. The anterior antennæ and the spines of the swimming feet present well-marked specific characters, and are quite unlike those of any other species known to me.

5. *Euchæta australis*, n. sp. (Pl. XXI. figs. 5–11).

Length, 1–6th of an inch (4·2 mm.). Cephalothorax elongated, robust; anterior antennæ as long as the body, in the *female* twenty-four- in the *male* twenty-one- (?) jointed; the basal joints more or less villous; in the *female* several of the joints bear single long apical setæ, the rest have two or more very short hairs; in the *male* (fig. 6) there are no excessively long setæ, and the shorter ones are but few. The terminal spines of the swimming feet (fig. 11) are not so coarsely serrated as in *Euchæta philippii*, the serræ being about twenty-five on each spine; and the secondary spines are quite small. The general characters of the feet and mouth-apparatus in both sexes are those of a normal *Euchæta*. The first abdominal segment of the *female* (fig. 10) is serrated at the outer angles, the caudal stylets are about as long as broad, the tail setæ equal and densely plumose.

Habitat.—Between Api and Cape York; and in a deep-sea gathering down to 2650 fathoms, lat. 36° 44′ S., long. 46° 16′ W. (Station 325).

It is of course impossible to say at what depth the specimens brought up in the net from 2650 fathoms were really caught, but as one at least of the species belonging to this gathering (*Euchæta gigas*) has been found in no other, it seems probable that they were brought from a great depth; and I entertain no doubt whatever that it is from the abyssal water and from the bed of the sea itself in those regions, as well as in more moderate depths, that we must now hope to obtain interesting or novel examples of Copepoda. In some specimens of *Euchæta australis* there was a brightly refracting spot near the middle of the first body-segment, which may perhaps be a pleural eye, but I was unable to obtain a sufficiently distinct view to satisfy myself as to its nature.

6. *Euchæta gigas*, n. sp. (Pl. XXII. figs. 1–5).

Length, 22-100ths of an inch (5·25 mm.). *Female.*—Body robust, obtusely angulated in front, posterior lateral angles of the thorax armed with sharp slender spines: anterior antennæ (fig. 2) as long as the cephalothorax, twenty-three-jointed, joints from the third to the seventh very short, eighth about twice as long, last six joints the longest; the limb is provided throughout its whole length with marginal setæ, none of which are excessively long. The teeth of the mandible (fig. 3) are very strong, the two larger ones with falcate apices. The terminal spines of the swimming feet (fig. 4) are closely and finely serrated on the outer, and very densely setose on the inner margin. Abdomen four-jointed, short; caudal stylets very short, broader than long; tail setæ four, spreading, subequal, very densely plumose, not longer than the abdomen.

Habitat.—Lat. 36° 44′ S., long. 46° 16′ W., down to 2650 fathoms (Station 325).

Very few specimens only were seen, and I am not quite certain as to the sex of some of these. The mandible, I think, was present in all the specimens I have examined, and if so the species will probably have to be referred to some other genus than *Euchæta*, seeing that in one example a fifth pair of feet (fig. 5), apparently those of an immature male, was observed. The structure of the swimming feet, however, as well as of the other mouth-organs agrees entirely with the normal *Euchæta*.

7. *Euchæta barbata*, n. sp. (Pl. XXII. figs. 6–12).

Length, 1-3rd of an inch (8·4 mm.). *Female.*—Anterior antennæ very slender (fig. 6), twenty-three-jointed (?), the fourth, eighth, ninth, and thirteenth joints each bearing an extremely long seta, the seventeenth and twenty-third joints having setæ of moderate length. The rostrum (fig. 7) and the posterior ventral angle of the thorax (fig. 12) have beard-like tufts of setæ, and so also has the last joint of the abdomen. The longer setæ of the first pair of foot-jaws (figs. 8–10) are ringed and densely pectinated, while the processes which bear the shorter (proximal) setæ are clothed with fine hairs (fig. 9). The feet are constructed exactly as in the normal *Euchæta*, but the terminal spines are extremely slender (fig. 11) and very finely serrated. Abdomen moderately long (fig. 12), four-jointed, the first joint very large and angularly protuberant in front; caudal setæ subequal, densely setose, about as long as the abdomen.

Habitat.—Lat. 36° 44′ S., long. 46° 16′ W., down to 2650 fathoms (Station 325). This fine species, of which only one example was seen, is sufficiently distinguished from all others by the beard-like appendages of the forehead and thorax, the armature of the first foot-jaw, the very slender apical spines of the swimming feet, and by the characters of the anterior antennæ.

Candace, Dana.

Candacia, Dana, Amer. Journ. Sci., 1846.
Ifionyx, Kröyer, Nat. Tidskr., 1849.
Candace, Dana, Crust. U. S. Expl. Exped., 1852.

Head consolidated with the first thoracic segment. Anterior antennæ twenty-three- or twenty-four-jointed, that of the male on the right side geniculated, and having the median joints only slightly swollen. Posterior antennæ stout, main stem composed of a large base and a small bilobed apical joint, secondary branch two-jointed, first joint almost obsolete. Mandibles twisted, narrow, ending in two stout teeth, the palp very much expanded. Maxilla bearing a long styliform process, masticatory portion subtriangular. First pair of foot-jaws very large and having long uncinate setæ, second pair very small, seven-jointed. Inner branches of the swimming feet two-jointed.

Fifth pair of feet in the female composed of one triarticulate branch on each side; those of the male dissimilar, the right usually prehensile. Abdomen composed in the female of three, in the male of five somites. Rostrum short and rounded.

The chief distinctive characters of the genus *Candace* are found in the very largely developed anterior, and almost obsolete posterior foot-jaw; the armature of the anterior, consisting of numerous very strong non-ciliated uncinate setæ. The right antenna of the male is always strongly geniculated, swollen in the middle, and usually provided with dentated marginal plates, and several of the basal joints are strongly toothed on the outer margin. The first abdominal somite in the adult female is often greatly swollen and angulated. The eyes are two lateral refracting bodies with one unpaired central ocellus. The external margins of the outer branches of the swimming feet are often finely pectinated, and those of the third and fourth pairs coarsely serrated towards the apex.

The genus is widely distributed, often occurring in considerable numbers. Its members may usually be distinguished at a glance, often even without the help of a lens, by the deep brown or black colouring which pervades parts, or sometimes the whole, of the body. The parts most liable to this coloration are the swimming feet, the anterior part of the long antennæ, and the cephalothorax. Only rarely is a specimen found entirely without colouring, some tinge of brown being almost universally visible in the tips of the various spines, or in the plumes of the feet, even when the rest of the animal is colourless.

1. *Candace pectinata*, Brady (Pl. XXX. figs. 1–13).

Candace pectinata, Brady, Monog. Brit. Copep., vol. i. p. 49, pl. viii. figs. 14, 15, and pl. x. figs. 1–12.

Length, 1-8th of an inch (3·1 mm.). Cephalothorax (figs. 1, 2) robust, truncated in front, scarcely at all tapered towards the extremities, posterior lateral angles produced into strong spines. Anterior antennæ as long as the cephalothorax (fig. 3), twenty-three-jointed, several of the basal joints (third to seventh) bearing strong marginal teeth; the setæ are irregular in size, those at the apex of some joints being very long, the rest comparatively short; in the *male* (figs. 4–6) the seventeenth joint of the right antenna (that on the proximal side of the hinge) bears a strongly pectinated crescentic marginal plate, the central teeth of which are the largest; the sixteenth joint is minutely pectinated, and the eighteenth bears a short beard-like fringe of setæ; several of the basal joints bear short, club-shaped sensory filaments; joints from the seventh to the eleventh on the right side,—seventh to tenth on the left side (and on both sides in the *female*), very small. The terminal spines of the third and fourth pairs of swimming feet are usually twisted at the apex; the inner branches, and the inner halves of the outer branches (figs. 7, 8), are mostly coloured brown or black, the setæ also deeply coloured

and densely plumose. The right foot of the fifth pair in the *male* (figs. 9, 10) is shorter than the left, and ends in a prehensile hand, one limb of which is broad and rounded, bearing two or three short apical setæ, the other forms a falciform claw; the foot of the left side consists of four nearly equal joints, the last two being more or less copiously ciliated. In the *female*, the feet of the fifth pair (figs. 11, 12) are cylindrical, three-jointed, the last joint elongated, subulate, and bearing two or three apical teeth. In the adult *female* the first abdominal segment (fig. 1) is usually produced at each side into a triangular prominence; the caudal stylets are extremely small, the setæ spreading, subequal, and about as long as the abdomen. The *male* abdomen (fig. 13) has the first somite produced on the right side only, forming a large spine-like acutely-angular projection.

Habitat.—*Candace pectinata* occurred in very many of the Challenger surface gatherings, often in considerable abundance. The species has a wide range of distribution, ranging from Australia in the south-east to the Scilly Islands in the north-west. Though so common a form, I cannot identify it with any of the species described in Dana's great work, probably on account of the insufficiency of the descriptions there given. It is the only member of the genus which has been met with in the British Seas, but does not appear among the Mediterranean species described by Dr. Claus.

The following are the localities of the Challenger captures:—off Cape Howe, Australia; off Port Jackson; between Sydney and Wellington; between Api and Cape York; in various places about the Philippine Islands; and at several Atlantic Stations between Ascension and the Azores.

2. *Candace pachydactyla*, Dana (Pl. XXXI. figs. 2–9).

Candace pachydactyla, Dana, Crustacea U. S. Expl. Exped., p. 1113, pl. lxxviii. fig. 2, *a.b.*

Length, 1-8th of an inch (3·1 mm.). In general form like *Candace pectinata*. The apical portion of the anterior antennæ (figs. 2, 3) is usually deeply coloured; the coalesced seventeenth and eighteenth joints of the right *male* antenna (figs. 3, 4) are densely pectinated with short, rigid setæ, and the nineteenth joint bears a shorter series of similar setæ; relative sizes of the joints as in the preceding species. The outer branches of the swimming feet have the last joint only deeply coloured throughout, the inner branches are uncoloured; the terminal spines usually short and twisted. The right foot of the fifth pair in the *male* (fig. 6) is prehensile, the second joint forming a blunt, falciform claw, which opposes a broad, ovate third joint; the foot of the left side is longer, four-jointed, the two terminal joints sparingly setiferous; in the *female* (fig. 8) the fifth pair of feet are stout, three-jointed, the last joint divided at the apex into three stout teeth, bearing a few short marginal setæ, and on the middle of the outer margin a single tooth. The abdomen of the *male* (fig. 9), like that of *Candace pectinata*, forms on the right side

a strong spinous projection, which nearly meets a corresponding spine of the right thoracic angle.

Habitat.—Off Port Jackson, Australia; between Sydney and Wellington; off Kandavu, Fiji; Philippine Islands; lat. 36° 48′ S., long. 39° 36′ W.; several stations in the Atlantic, between lat. 10° S. (near Ascension Island) and 27° S. (west of the Canaries).

From the list of localities it will be seen that the distribution of this species is almost identical with that of *Candace pectinata*. The points of difference between the two are to be found in the style of armature of the right male antenna, and in some slight divergences in the fifth feet of both sexes. And, as far as I have been able to observe, the distribution of colouring in the swimming feet affords a good diagnostic mark; in *Candace pectinata* the colouring extends over only half the breadth of the outer branch, but (usually) over the whole of the inner branch; in *Candace pachydactyla* the whole of the last joint of the outer branch is coloured, while the inner branch is altogether colourless.

Several male specimens showed an immature form of the fifth pair of feet (fig. 7), and in these the anterior antennæ had not taken on the special characters of the male.[1]

3. *Candace truncata*, Dana (Pl. XXVIII. figs. 12–15, and Pl. XXIX. figs. 1–14).

Candace truncata, Dana, Crust. U. S. Expl. Exped., p. 1118, pl. lxxviii. fig. 8, *a–d*.
? „ *bispinosa*, Claus, Die frei lebenden Copepoden, p. 191, pl. xxvii. figs. 9–16, and pl. xxxiii. fig. 5.

Length, 1–12th of an inch (2·1 mm.). Cephalothorax truncated both in front and behind, posterior lateral angles rounded off or obtusely angular, not spined, anterior antennæ twenty-four-jointed, the joints more nearly equal in length than in the foregoing species; several of the basal joints (fig. 4) bearing long, slender spines. The right anterior antenna of the *male* (fig. 2) has no denticulated plates, and the joints, both on the distal and proximal sides of the hinge, are nodose at their apices. Outer margins of the swimming feet very finely serrated. Terminal spines of the swimming feet (figs. 7, 8) nearly straight (rarely twisted). Fifth pair of feet of the *male* (fig. 9) non-prehensile, that of the right side simple, three-jointed, short, bearing a long straight, plumose, apical setæ, which reaches as far as the apex of the left foot; left foot four-jointed, sparingly setiferous at the apex. The fifth pair of feet in the *female* (fig. 10) is small, the last joint elongated, with two small apical and two marginal teeth, and on the inner margin two or three setæ. The first somite of the *female* abdomen has large triangular lateral processes, that of the *male* is simple. Animal usually colourless.

[1] Sir John Lubbock, in his paper on the Entomostraca collected by Dr. Sutherland (*Trans. Entom. Soc.*, 1856), appears to have made his drawings of *Candace pachydactyla* from a male of that species and a female of *Candace truncata*, himself expressing a suspicion that more than one species were mixed together in his material.

Habitat.—Between Api and Cape York; off Kandavu, Fiji; off south coast of Papua; at several Stations off the Philippine Islands; Pacific, north of Sandwich Islands; Atlantic, lat. 27° N.; lat. 46° 46′ S., long. 45° 31′ E.; lat. 64° 37′ S., long. 85° 49′ E.; lat. 9° 43° S., long. 13° 51′ W.

The slender, straight spines and exceedingly fine serrations of the swimming feet, the absence of denticulated plates on the right male antenna, the non-prehensile fifth feet of the male, and the usual colourlessness or very sparing coloration of the animal, serve to distinguish this from any other described species. Except in the structure of the fifth pair of feet in the female, the species described by Claus as *Candace bispinosa* seems to agree entirely with *Candace truncata*. The specimens from which my drawing (Pl. XXIX. fig. 11) was made, occurred in a gathering from the Atlantic, north of Ascension Island, and are undoubtedly identical with *Candace bispinosa*, Claus; but I have not been able to detect any other character separating them from *Candace truncata*, Dana, and therefore prefer, for the present at any rate, to consider them as a variety of that species.

Dana's statement of a "twenty- to twenty-two-jointed" antenna does not apply to this species, but the joints near the base of the limb are often difficult to see, and almost impossible to count correctly with low powers of the microscope. The figures here given (Pl. XXIX. figs. 1, 3) show different numbers of joints, fig. 1 having been drawn with a low power and left uncorrected, fig. 3 with a higher power. One of the diagnostic marks given by Dana—"second joint stout, not longer than third or fourth,"—would thus apply to our fig. 1, but not to fig. 3.

Corynura,[1] n. gen.

Cephalothorax slender, cylindrical, head coalescent with first thoracic somite, abdomen five-jointed in the male, three-jointed in the female. Right anterior antenna of the male geniculated, and provided with serrated plates. Mandible-palp bearing two small one-jointed branches. Maxilla destitute of a palp, composed of a stout setiferous base and a slender, one-jointed apical portion. Anterior foot-jaw as in *Acartia*, excepting that the setæ are for the most part not plumose; posterior foot-jaws also like those of *Acartia*, but that the apical portion is rudimentary and uniarticulate. Fifth pair of feet simple, unbranched, in the male prehensile. Caudal stylets much elongated, and dilated at the apices. One large eye (?) situated in the front of the forehead.

The anterior antennæ and fifth pair of feet are closely similar to the same organs in *Pontella*, but the peculiar structure of the maxillæ, the unjointed (or very indistinctly jointed) and rudimentary apex of the posterior foot-jaw, together with the remarkably

[1] κορύνη, a club; οὐρά, a tail.

elongated abdomen and tail are characters of sufficient importance to demand generic recognition. In the very largely developed posterior foot-jaw there is a resemblance to *Candace*.

1. *Corynura gracilis*, n. sp. (Pl. XXXIII. figs. 1–14).

Length, 1–12th of an inch (2·1 mm.). Abdomen slender, very much narrower than the cephalothorax (fig. 1), head marked by a deep transverse groove. Anterior antennæ slender, not quite as long as the body; fifteen-jointed (?) somewhat nodose and furnished with rather long setæ,—sparsely, except at the apex, which bears a brush of five or six long, and, in the *male*, finely plumose hairs. Two joints on the proximal, and one on the distal side of the hinge joint in the *male*, are very finely denticulated, and in the middle of the swollen portion of the limb is a strong, deflexed, marginal tooth; the last denticulated joint also has a spine at the apex. Inner branch of the posterior antenna (fig. 5) of moderate length. Mandible (fig. 6) deeply and sharply toothed, the teeth densely ciliated, palp bearing two short, one-jointed branches. Basal portion of the maxilla (fig. 7) stout, bearing a series of eight or nine ciliated setæ, apical portion simple, with three curved terminal setæ. Apical portion of the posterior foot-jaw (fig. 9) very indistinctly three-jointed, rudimentary, feebly setiferous at the extremity. Swimming feet like those of *Acartia*, except that the marginal spines are distinctly articulated to the limb. Fifth pair of feet in the *female* (fig. 12) simple, two-jointed, the last joint curved, awl-shaped, slightly dentated at the apex; in the *male* strongly hooked and prehensile. The tail is very long, constricted at the base (figs. 13, 14) and, in the *female* dilated and spathulate at the apex; in the *male* it is slender, dilated at the apex, but without any marked basal constriction; there is a small marginal hair on the middle of each caudal stylet; the terminal setæ are much shorter than the abdomen and subequal.

Habitat.—This remarkable species was found in four gatherings from near the Philippine Islands, in all cases rather sparingly.

The jointing of the anterior antennæ, especially near the base, is very indistinct, and it is impossible, from spirit specimens at any rate, to state with accuracy the number of the joints. The same remark applies very frequently to *Pontella* and other allied genera.

2. *Corynura barbata*, n. sp. (Pl. XXXI. figs. 10–12).

Female.—Like the preceding, except that the caudal stylets (fig. 12) are shorter and stouter, and have a long seta on the middle of the external margin. The anterior antennæ are very obscurely jointed, and the fifth pair of feet (fig. 11.) are unequal in size, the larger one angularly produced in the middle, and bearing on the projection a shaggy setose fringe.

One specimen only was found amongst the Copepoda from Zebu Harbour, Philippine Islands. The parts were not very clearly made out on dissection, but so far as appears, the individual is not referable to any known species.

Acartia, Dana.

Acartia, Dana, Amer. Journ. Sci., 1846.
Dias, Lilljeborg, Crust. ex. ord. trib., 1853.
„ Claus, Die frei lebend. Copep., 1863.
„ Boeck, Oversigt Norges Copepoder, 1864.
„ Brady, Monog. Brit. Copep., 1878.

Body long and slender, head produced into a slender rostrum, abdomen composed in the male of five, in the female of three, segments. Anterior antennæ in the female twenty-jointed, bearing scattered long setæ, nodose, and in the male, on the right side, geniculated. External branch of the posterior antenna long, three-jointed; internal branch short, one-jointed. Labium very large, three-lobed, setiferous, the middle lobe very broad. Mandible-palp of moderate size, two-branched, branches short, one- or two-jointed. Anterior foot-jaws large, bearing numerous uncinate setæ, which are pectinated as in *Pontella;* posterior composed of a broad basal, and a more slender apical portion; the basal part provided with four or five very long plumose setæ, the apical part sparingly aculeate. Internal branches of the swimming feet two-jointed, outer branches three-jointed. Fifth pair of feet one-branched, prehensile in the male, in the female rudimentary, consisting of a small basal joint, from which spring two slender, unequal setæ. Eye mobile, formed of several lenses.

The genus *Acartia*, though very imperfectly characterised and figured by Dana, was evidently meant to include the species belonging to Lilljeborg's more recently established genus *Dias*. Dana, however, does not appear to have seen the male of any of the four species described by him; and this accounts for his guarded statement as to the non-geniculation of the male antennæ. Indeed the males of the pelagic species of *Acartia* seem to be very scarce. I carefully hunted for them in all the gatherings which have come under my notice, and only found one example,—a remarkable fact, seeing that in any gathering of the well-known European species, *Acartia longiremis*, males are quite commonly met with. The geniculation of the right anterior male antenna is rather indistinct, but the limb is considerably swollen for the insertion of flexor muscles; the posterior antenna has on the second joint of its larger branch a marginal series of rather long hairs. The marginal spines of the swimming feet differ from the common type in being continuous with the joints of the limb, and not articulated appendages. The terminal spines are narrow, sword-shaped, and finely serrated, and in length are more than equal to the whole outer branch.

This genus, in the structure of its mouth apparatus, especially of the foot-jaws, shows a close relationship with *Pontella*, but the imperfect geniculation and absence of serrated plates in the anterior antennæ of the male, the peculiarly nodose and laxly setiferous character of those organs, the rudimentary form of the fifth pair of feet (especially in the female), and the small secondary branch of the posterior antenna, together with various minor differences in the spinous armature of the swimming feet, amply distinguish it from that genus.

From *Corynura*, a still more closely related genus, it is separated by the absence of serrated antennal plates, and by the structure of the maxillæ and tail.

All the members of the genus are usually colourless and almost transparent; and though not occurring so abundantly as many other Copepoda, are very widely distributed in all the great oceanic areas.

1. *Acartia laxa*, Dana (Pl. XXXII. figs. 1–11).

Acartia laxa, Dana, Crust. U. S. Expl. Exped., p. 1123, pl. lxxix. fig. 5, *a–c*.

Length, 1–18th of an inch (1·4 mm.). *Female.*—Cephalothorax (fig. 1) elongated, very slightly tapered towards each extremity, obtusely pointed in front, truncated behind, posterior lateral angles produced into sharp, slender spines. Anterior antennæ (fig. 2) as long as the body, of nearly equal thickness throughout, bearing a few very long setæ, which are distributed somewhat as follows:—three or four near the base, on the third, fourth, and fifth joints; two or three in the middle, on the tenth and eleventh joints, and ten on the last five joints. The fifth pair of feet small (fig. 10), their two setæ about equal in length. The first segment of the abdomen (fig. 11) is equal in length to the remaining four, tumid, and armed with a slender spine on the posterior dorsal angle; the second segment is much produced downwards and backwards; caudal segments short, about as broad as long; setæ equal, spreading widely in a fan-shaped manner, and about as long as the abdomen.

Habitat.—Philippine Islands; between Arrou and Banda; Atlantic Ocean at several points between lat. 12° 16′ S., and lat. 10° 55′ N.

The presence of spines on the posterior lateral angles of the cephalothorax is the most tangible distinction between this and the following species; there is also a slight difference in the structure of the fifth pair of feet in the female (those of the male have not been seen), and in the anterior antennæ, which in *Acartia laxa* show no toothed marginal processes.

2. *Acartia denticornis*, n. sp. (Pl. XXXI. fig. 1, and Pl. XXXII. figs. 12–17).

(?) *Acartia limpida*, Dana, Crust. U. S. Expl. Exped., p. 1119, pl. lxxix. fig. 2, *a.b.*

Length, 1–22nd of an inch (1·1 mm.). In general shape similar to *Acartia laxa*, except that the posterior angles of the cephalothorax are rounded off, and destitute of

spines. The setæ of the anterior antennæ are distributed pretty much as in *Acartia laxa*, but the joints, just above the origin of each seta, are angularly produced in a tooth-like fashion. In the *male* (Pl. XXXII. fig. 12) the right anterior antenna is swollen below the middle, but is only indistinctly geniculated. The fifth foot in the *male* (fig. 15) is angularly bent, the penultimate joint bearing a stout subquadrate marginal process, the last forming a distorted, acuminate claw: in the *female* (fig. 16) the basal joint is short and broad, with truncated and angular apex, the two terminal setæ nearly equal in length, the inner one dilated at the base, the outer much more slender. The abdomen and tail setæ do not differ materially from those of *Acartia laxa*.

This is very similar to Dana's *Acartia limpida*, but some parts of the description cannot rightly apply to our species, as, for instance, "caudal stylets longer than twice their diameter," and "one seta of the posterior foot quite long and a little curved, the other less than a fourth as long"; moreover, the angular or toothed articulations of the anterior antennæ are not mentioned as characterising *Acartia limpida*.

Habitat.—Abundant in Hilo Harbour, Sandwich Islands (August 1875); one or two specimens noted in a gathering from the Philippine Islands, and (?) in the Atlantic, north of Tristan d'Acunha.

Calanoides, n. gen.

Cephalothorax six-jointed (in the male the first joint is barely visible), head united with the thorax; abdomen of the male five- of the female four-jointed. Anterior antennæ twenty-four-jointed, nearly alike in both sexes. Branches of the posterior antennæ nearly equal in length, inner branch with three small median joints. Mandible-palp well developed, biting portion of the mandible well developed in the female, very feebly or altogether wanting in the male. Maxillæ and foot-jaws as in *Calanus;* the foot-jaws very small in the male.[1] Five pairs of feet in both sexes; the inner and outer branches three-jointed throughout, except in the fifth pair of the male, which are very long, prehensile, and in which the inner branches are rudimentary.

In general appearance, in the structure of the antennæ, maxillæ, foot-jaws, and swimming feet, we have here an almost exact agreement with *Calanus;* but the absence of mandible proper in the male, and the conformation of the fifth pair of feet in the same sex, are characters which ally the genus to *Euchæta*, under which I was at one time disposed to place the single species known to me. Some of the most conspicuous characters of *Euchæta* are however wanting, as, for instance, the single long caudal seta, and the large doubly flexed posterior foot-jaws; while the three-jointed inner

[1] In the two or three males which I dissected I was unable, except in one instance, to find any trace of the mandible proper; in one case, however, I observed a process, not unlike that figured by Giesbrecht as belonging to the male *Lucullus acuspes*, and which may possibly represent the mandible.

branches of the first and second swimming feet, and the presence of a fifth foot in the female, constitute other important points of distinction. But the most nearly allied genus appears to be one recently described by Dr. Giesbrecht, under the name *Lucullus*, in which, however, the anterior antenna of the male is only nineteen-jointed, and there are but four pairs of swimming feet in the female.

Calanoides patagoniensis, n. sp. (Pl. XXIII. figs. 1–10).

Length, 1-10th of an inch (2·55 mm). Rostrum bifid to the base, each branch very slender and produced into a long filament. Anterior antennæ about as long as the body, slender, sparingly setiferous, the joints rather constricted in the *male*. Branches of the mandible-palp (figs. 3, 4) two-jointed, short. Second foot-jaw of the *male* (fig. 7) bearing two reflexed, densely plumose setæ (as in *Calanus*). Swimming feet (fig. 8) slender, the marginal and terminal spines long and slender. Fifth pair of feet of the *male* (fig. 9) very long and slender, reaching considerably beyond the extremity of the abdomen, that of the left side the longest, the second joint of each side bearing at its apex a short rudimentary inner branch, which on the left side is one-jointed and almost obsolete, on the right longer and three-jointed: the main branch of each limb ends in a long spine-like seta. Abdomen in both sexes slender; caudal stylets about as long as broad; setæ subequal, the longest scarcely longer than the abdomen.

Habitat.—This species occurred in some abundance in a surface-net gathering in the South Pacific, lat. 46° 53′ S., long. 75° 11′ W. (Station 304).

Ætidius,[1] n. gen.

Cephalothorax composed of four segments; head and thorax coalescent; anterior antennæ twenty-four-jointed; posterior antennæ and mouth-organs (in the female at any rate) like those of *Calanus*. Four pairs of feet only in the female; five pairs in the male, the fifth pair rudimentary, though composed of two branches. Inner branch of the first pair one-jointed, of the second (indistinctly) two-jointed; of the third and fourth three-jointed. Abdomen of the male five- of the female four-jointed; tail setæ equal.

In general structure this is very closely similar to *Calanus*, the only important differences being found in the jointing of the inner branches of the swimming feet, the absence of a fifth pair in the female, and the rudimentary character of those organs in the male. The mandibles and foot-jaws are small, but I have not observed whether their characters materially differ in the two sexes. I have seen, I think, only one or two males, and my examination of them was made before I was aware of the great importance of sexual characters in these parts.

[1] ἀετιδεύς, eaglet (from the strongly-hooked rostrum).

Ætidius armatus, n. sp. (Pl. X. figs. 5–16).

Length, 1-12th of an inch (2·1 mm.). Front of the head very broadly rounded, rostrum very stout, cleft to the base and produced in a continuous curve from the forehead. Last thoracic segment much produced, composed apparently of two fused somites, and forming at each side a backward-pointing spine, which is as long as the first abdominal segment. Anterior antennæ twenty-four-jointed (fig. 6), about as long as the body, the eighth joint longer than those which immediately precede and follow it; the joints from the fifteenth onwards are longer and more slender than the rest, except the last, which is very small; all the joints bear setæ, most of which are small, and none of excessive length. The two branches of the posterior antennæ (fig. 7) are nearly equal, and the inner branch has four very small median joints. The basal joint of the mandible-palp (fig. 8) is large, the two branches small and indistinctly two- and three-jointed. Maxillæ and both pairs of foot-jaws (figs. 9, 10) small, and like those of *Calanus*. The inner branch of the second foot shows an indistinct division near the base (fig. 12) into two joints; those of the third and fourth pairs are distinctly three-jointed (figs. 13, 14), but the first joint is in both cases very small. The fifth pair of the *male* (fig. 15) is almost obsolete, the outer branch composed of three, the inner of only one joint, and entirely destitute of setæ. Caudal segments about twice as long as broad, setæ nearly equal, and as long as the abdomen.

Habitat.—Indian Ocean in lat. 46° 46′ S., long. 45° 31′ E. (Station 146); in Torres Straits, off Port Jackson, at night; Chinese Sea, in lat. 17° 54′ N., long. 117° 14′ E. (Station 206); in lat. 32° 24′ S., long. 13° 5′ W. (Station 335); and in lat. 3° 10′ N., long. 14° 51′ W. (Station 348).

The strong curved rostrum, and the remarkably elongated, spiniform, posterior thoracic segment distinguish this species at a glance from any other with which I am acquainted.

Drepanopus,[1] n. gen.

Head and thorax coalescent. Anterior antennæ twenty-three-, twenty-four-, or-twenty-five- jointed, nearly alike in both sexes. Posterior antennæ and mouth-organs as in *Calanus*. Inner branches of first pair of feet one-jointed; of the second pair one- or two-jointed; of third and fourth pairs three-jointed. Fifth pair in the female rudimentary, composed of one branch only, in the male two-branched, prehensile, dissimilar on the two sides; inner branch rudimentary. Abdomen of the male five- of the female four-jointed.

The number of joints in the swimming feet here corresponds with that of the preceding genus, *Ætidius*, but the presence of a fifth pair in the female, and the prehensile

[1] δρέπανον, a sickle; πούς, a foot.

character of the same member in the male, preclude the possibility of referring both forms to the same genus. I therefore propose the name *Drepanopus*, which first suggested itself as being applicable to the fifth pair of feet of the female *pectinatus*.

1. *Drepanopus pectinatus*, n. sp. (Pl. XXIV. figs. 1–11).

Length, 1-9th of an inch (2·7 mm.). Forehead rounded, rostrum short and slender; anterior antennæ twenty-three-jointed in the *male*, twenty-four-jointed in the *female*, as long as the cephalothorax, beset with short setæ, the proximal half in the *male* (fig. 3) bearing numerous stout club-shaped sensory appendages, the first and eighth joints in both sexes much longer than the rest. The inner branches of the second, third, and fourth feet have the first joint very small (figs. 8, 9), the marginal spines are sharp and slender, and the terminal spines are long, bayonet-shaped, and closely serrated. The fifth pair of feet in the *female* (fig. 10) are simple, three-jointed, the first two joints short and tumid, the third joint slightly swollen at the base and produced into a long curved extremity, the distal half of which is pectinated on its outer margin. In the *male* (fig. 11) the fifth pair is prehensile, the right limb terminating in a long falcate claw; the left limb is much shorter, and the inner branches of both sides are almost obsolete, consisting only of a single minute joint.

Habitat.—*Drepanopus pectinatus* occurred very abundantly in three surface-net gatherings; the first, indeed, consisted entirely of this species, and was taken (approximately) in lat. 47° S., long. 61° E.; the second and third were from Betsy Cove, Kerguelen Island, and from the open sea off the same place, so that the species, so far as our present knowledge goes, is confined to very narrow limits. Only one male was found, after looking over a very large number of specimens.

2. *Drepanopus furcatus*, n. sp. (Pl. IV. figs. 1, 2, and Pl. XXIV. figs. 12–15).

Length, 1-18th of an inch (1·4 mm.). Anterior antennæ as long as the cephalothorax, very similar to those of *Drepanopus pectinatus*, but the eighth joint is not larger than the rest, and the whole limb is less profusely setose. Mouth-organs and swimming feet also like those of *Drepanopus pectinatus*, except that the inner branch of the second foot (fig 12) is one-jointed, and the terminal spines (fig. 14) are shorter, stouter, and more finely serrated. The fifth pair in the *female* (fig. 15) is short and two-jointed, the last joint forked at the apex. *Male* unknown.

Habitat.—This species, like the last, was found in three gatherings, but only sparingly. The three localities belong to totally distinct areas, and are as follows:—off Cape Howe, Australia, at night; in the tow-net, at a depth of 20 fathoms, in lat. 33° 31′ S.; long. 74°

43′ W. (Station 299), this Station being off the west coast of South America, in the latitude of Valparaiso; and in lat. 5° 28′ N., long. 14° 38′ W. (Station 349), the last-named Station being in the Atlantic, a little south-west of Sierra Leone.

Phyllopus,[1] n. gen.

Anterior antennæ twenty-four-jointed. Maxilla-palp rudimentary. Inner branches of all the swimming feet three-jointed (?) Fifth pair in the male (?) one-branched, the last joint leaf-like.

Phyllopus bidentatus, n. sp. (Pl. V. figs. 7–16).

Length, 1-7th of an inch (3·6 mm.). Anterior antennæ (fig. 7) having the joints from the eighth to the twelfth very short, only about half as long as broad, seventh, ninth, and fourteenth joints each bearing a single very long seta, the rest having short setæ, except the terminal one, which bears a lash of four setæ, two of them longer than the rest; the first joint is armed close to its origin with a long and slender curved spine, and all the shorter setæ of the limb are very straight and rigid, very obliquely truncate at the tips, the longer margin being produced into a short, extremely delicate filament, the whole having much the appearance of the nib of a quill pen; the last five joints are very much dilated at the apices,—more so than is represented in the figure. Mandibles (fig. 8) slender, divided at the apex into five long, slender teeth; palp having a large wedge-shaped base and two branches, one of which has two, the other four joints. The maxilla-palp (fig. 9) consists of a small ovate plate bearing six setæ, and a small two-jointed, setiferous digit. Anterior foot-jaw (fig. 10) stout, its marginal processes stout and triangular; posterior (fig. 11) small, the basal joint dilated. The last joint of the fifth foot (fig. 12) forms a leaf-like lamina, with deeply serrated margin, the innermost serration produced and larger than the rest; the penultimate joint bears on its inner margin a long, stout seta. Abdomen four-jointed, the first joint much stouter and longer than the rest (figs. 13, 14); caudal stylets about twice as long as broad; second tail-seta longer than the abdomen, the rest about half as long. Terminal spines of the swimming feet lancet-shaped (fig. 15), margin very finely pectinated. Rostrum (fig. 16) very short, bifid. Last thoracic segment (fig. 13) produced ventrally into a stout bidentate process.

Habitat.—Lat. 36° 44′ S., long. 46° 16′ W., down to 2650 fathoms (Station 325). One specimen only of this animal was seen, and in the anticipation of further specimens being available, was unfortunately only very imperfectly examined. The size of the first

[1] φύλλον, a leaf; πούς, a foot.

abdominal somite led me to suppose that the specimen described was a female; the characters of the anterior antenna and fifth feet, however, are rather those of the male.

Temora, Baird.

Calanus (in part), Leach, Dict. Sci. Nat.
Temora, Baird, Brit. Entomostraca, 1850; Claus, Die frei lebenden Copepoden, 1863; Boeck, Oversigt Norges Copepoder, 1864; Brady, Monog. Brit. Copep., 1878.
Diaptomus, Lubbock, Trans. Entom. Soc., 1856.

Body elongated; head distinct from the thorax; rostrum furcate. Fourth and fifth thoracic segments either completely coalescent, or their separation indicated merely by a furrow. Abdomen composed of four or five segments in the male; of three in the female. Anterior antennæ twenty-four- or twenty-five-jointed; that of the right side in the male geniculated. Mouth-organs as in *Calanus*. Inner branches of the swimming feet usually two-jointed. Fifth pair of feet in both sexes one-branched; in the male forming prehensile organs.

The type of this genus is *Temora longicaudata* (Lubbock); a species in which the inner branches of the swimming feet are all two-jointed, except, perhaps, in the case of the first foot, where the division into two joints is often only indistinctly visible. For the most part the two joints are perfectly distinct, even in the first foot, and they are so figured by Dr. Baird. Claus, however, has made it part of his definition of the genus *Temora* that the inner branch of the first foot is single-jointed, while those of the second, third, and fourth pairs are two-jointed. Though this is correct as to one of the European species (*Temora velox*), it is not so, as regards the first foot, with *Temora longicaudata*, and in the case of *Temora dubia*, now to be described, the discrepancy extends to the second and third feet of the female, where the inner branches are only one-jointed, while, on the other hand, the inner branch of the first foot is bi-articulate.

From *Calanus* and *Pseudocalanus* this genus is readily distinguished by the structure of the fifth pair of feet, and anterior antennæ of the male. From *Isias* and *Diaptomus* it is separated by differences in all five pairs of feet, though it must be admitted to be doubtful how far these generic distinctions may remain tenable as our knowledge of allied forms increases.

1. *Temora dubia* (Lubbock), (Pl. XXV figs. 1–17).

Diaptomus dubius, Lubbock, On some Entomostraca collected by Dr. Sutherland in the Atlantic Ocean, Trans. Entom. Soc., vol. iv. N. S., 1856, p. 21, pl. ii. figs. 1–7.

Length, 1-13th of an inch (1·95 mm.). Cephalothorax very robust, about half as broad as long, rounded in front, subtruncate behind, the posterior lateral angles produced into long spinous processes (fig. 16). Anterior antennæ of the *female* (fig. 3) about as long as the cephalothorax, twenty-four-jointed, the joints not varying greatly in length,

and uniformly clothed with short slender setæ; in the *male* (fig. 2) the right anterior antenna is swollen in the middle, and geniculated, the joints before and behind the hinge being armed with finely serrated plates. The inner branch of the posterior antenna (fig. 4) is five-jointed, the three median joints very small. The outer branches of the first four pairs of feet are, as a rule, three-jointed, but in the *female* those of the second, third, and fourth pairs are only two-jointed, and in the *male* that of the second pair is occasionally two-jointed; the inner branches are all two-jointed, except in the second and third feet of the *female*, where they are one-jointed (figs. 9, 10, 11). The terminal spines of the feet (fig. 15) are rather short and stout, their marginal teeth generally broad and distant. The fifth foot of the right side in the *male* (figs. 12, 13) is broad, its first joint produced laterally into a long twisted immobile claw-like finger, the last joint blunt, irregularly oval, and bearing a few small marginal setæ; the foot of the left side is simple, slender, and ends in a slender flexuous claw. Fifth pair in the *female* (fig. 14) simple, three-jointed, the last joint bearing one small marginal, and three unequal terminal, spines. Abdomen slender, in the *female* three-jointed, in the *male* (figs. 16, 17) five-jointed; caudal stylets very long and slender, about equal in length to the abdomen proper, and ten or twelve times as long as broad, bearing one long seta on the middle of the outer margin and four nearly equal apical setæ, which are about as long as the caudal stylet. The stylets themselves are frequently unequal in size and more or less distorted.

This species often occurs in great numbers, and seems peculiarly liable to "sports;" the caudal segments of the two sides are rarely quite alike, and are often very considerably distorted, and the build of the swimming feet is likewise extremely variable. The limb of one side may have a different number of joints from its fellow of the opposite side, so that the foregoing statement as to the normal arrangement of the joints must be taken as applying only to what appears to be the commonest condition, but subject, nevertheless, to very frequent variation.

Habitat.—Off Cape Howe, Australia; off Port Jackson; off Kandavu, Fiji; between Api and Cape York; in many localities off the Philippine Islands; lat. 37° 3′ S., long. 44° 17′ W. (Station 326); off Zamboanga; in the Arafura Sea; off the Ki Islands; in several Atlantic gatherings between lat. 3° N. and lat. 20° N.—very abundant in many of those gatherings.

2. *Temora armata*, Claus.

Temora armata, Claus, Die frei lebenden Copepoden, p. 195, Pl. xxxiv. figs, 12, 13.

A single specimen, agreeing closely with Dr. Claus's description of this species, but apparently immature, was taken off the west coast of Africa, in lat. 10° 55′ N., long. 17° 46′ W. One pair of swimming feet (fourth?) has both branches three-jointed, the rest

have both two-jointed. The general characters are those of *Temora;* rostrum and caudal stylets as figured by Claus.

Centropages, Kröyer.

Centropages, Kröyer, Nat. Tidskr., 1849.
„ Boeck, Oversigt Norges Copepoder, 1864.
„ Brady, Monog. Brit. Copepoda, 1878.
Catopia, Dana, Proc. Amer. Acad. Sci., 1849.
Calanopia, Dana (in part), Crust. U. S. Expl. Exped., 1852.
Ichthyophorba, Lilljeborg, De Crustaceis ex. ord. trib., 1853.
„ Claus, Die frei lebenden Copepoden, 1863.

Body elongated; head distinct from the thorax, produced into a cloven rostrum, and more or less distinctly divided by a transverse groove into two segments. Anterior antennæ twenty-four-jointed, that of the right side in the male geniculated and prehensile. Mandibles, maxillæ, and foot-jaws similar to those of *Calanus*, except that the setæ of the anterior foot-jaws are beset with strong marginal hairs as in *Pontella*. The five pairs of swimming feet have both branches three-jointed, except the outer branch of the left fifth foot in the male, which is only two-jointed, while on the right side the outer branch, though three-jointed, forms a doubly-clawed prehensile organ. Eye median and mobile, of moderate size.

From *Pontella* this genus is separated by the single eye, by the Calanoid form of the posterior foot-jaw, the three-jointed inner branches of the swimming feet, and by the peculiar structure of the fifth pair of feet in both sexes. From *Diaptomus*, *Temora*, and other nearly allied genera, the characters of the swimming feet, especially of the fifth pair, form a sufficient distinction, while from *Candace* it is further separated by the structure of the mouth-organs, more particularly of the mandibles and maxillæ.

The names *Catopia* and *Calanopia* were proposed by Dana, the one as a genus, the other as a sub-genus, to include certain species closely allied to *Pontella*. The characters relied upon do not, however, appear to be very important, or very serviceable as landmarks of classification, the two species assigned by Prof. Dana to *Calanopia* (*Calanopia elliptica* and *Calanopia brachiata*), belonging, in my view, to two distinct genera. The name *Centropages*, used by Kröyer in 1849, has precedence, of course, over the more lately published *Calanopia* and *Ichthyophorba*, while *Catopia*, though dating from the same year as *Centropages*, has not obtained the same currency, and, moreover, has scarcely been defined with sufficient precision.

Of this genus three European species have been described. *Centropages typicus*, Kröyer, *Centropages hamatus*, Lilljeborg, and *Centropages violaceus*, Claus; the last of which is by far the commonest representative of the group in the Challenger collection, occurring in at least ten of the surface-net gatherings. But though this one form is very

widely distributed, it does not appear that the genus is rich in species; only two others have been found amongst the Challenger captures, and these occurred but sparingly.

1. *Centropages brachiatus*, Dana (Pl. XXVI. figs. 1–7).

Calanopia brachiata, Dana, Crust. U. S. Expl. Exped., p. 1133, pl. lxxix. fig. 7, *a.b.*

Length, 8-100ths of an inch (4·4 mm.). Cephalothorax elongated, slightly constricted at the points of junction of the somites, posterior angles produced into strong hook-like spines; anterior antennæ slender and about equal in length to the body of the animal, the first two joints somewhat larger and stouter than those immediately following, those from the third to the eleventh very small, none of them being much longer than broad, the next three considerably longer; the fifteenth to the nineteenth are the longest of all, being about four times as long as broad, the apical joints somewhat shorter; the entire limb beset with rather short, slender setæ; the first, second, and fifth joints each bear on the outer margin a short, stout spine, and several of the lower joints, from about the seventh to the twelfth, have one or more aborted spines (fig. 2). The right anterior antenna of the *male* (fig. 3), in addition to the spines already mentioned, has well-developed spines on the tenth and eleventh joints; the twelfth, thirteenth, and fourteenth are greatly enlarged, the thirteenth and fourteenth having each a very strong spine; the fifteenth, sixteenth, and seventeenth joints are more slender, but about twice as long as the preceding, and are armed on the inner aspect with finely serrated plates, the hinge being situated between the sixteenth and seventeenth; the eighteenth joint is of equal size, but has no serrated plate; these four joints represent by coalescence seven joints of the normal antenna (15–21). The outer branch of the fifth foot in the *female* has the middle joint very short, and produced internally into a very long and strong spine, the margins of which are smooth. The outer branch of the right fifth foot in the *male* (fig. 6) forms a powerful, doubly-clawed, prehensile organ, the upper internal angle of the middle joint produced into an extremely long hooked claw, which opposes at its extremity the claw-like termination of the last joint; the lower outer angle also of the middle joint forms a long claw-like process, which is twisted to the inside so as to have the same direction as the upper claw; the foot of the left side has the outer branch two-jointed, equal in length to the inner branch, the last joint truncated, and bearing only three or four setæ at the apex. The first segment of the *female* abdomen has on each lateral margin two slender curved spines. The caudal segments are about twice as long as broad, and likewise twice as long as the last abdominal segment. Tail setæ subequal, short, the longest considerably shorter than the length of the abdomen, the four external setæ in the *female*, but not in the *male*, are conspicuously dilated towards the base. Eye small, composed of two closely approximated ocelli.

Habitat.—Several specimens of this species occurred in tow-net gatherings off

Valparaiso (Station 298), November 18, 1875, and from the west coast of Patagonia (Station 304), December 31, 1875. Prof. Dana's type specimens were from the Lagulhas Bank, near the Cape of Good Hope and from the South Pacific, in lat. 42° to 36°.

Though Dana's description does not quite accurately apply to the Challenger specimens, more especially as to the spinous armature of the antennæ (no notice being taken of the small spines near the base), I can scarcely doubt that it is meant to refer to the species here under review; the differences, at any rate, are not so great as to warrant my proposing a fresh specific name. It must be noted, however, that the size assigned by Prof. Dana to his species (1-12th of an inch) is only about half that of our specimens.

2. *Centropages furcatus*, Dana (Pl. XXVIII. figs. 1–11).

Catopia furcata, Dana, Crust. U. S. Expl. Exped., p. 1173, pl. lxxix. fig. 1, *a.–d.*

Length, 8-100ths of an inch (2 mm.). Body elongated, cylindrical, posterior angles of the cephalothorax produced each into two spines (figs. 1, 2), the outer spine much the longer of the two, and separated from the inner by a deep curve. Anterior antennæ spined on the first, second, and fifth joints, as in *Centropages brachiatus*, and agreeing generally with that species in length of joints; the right antenna of the *male*, however (figs. 3, 4), is more feebly serrated in the geniculating portion, and has no spines except on the basal joints, the median joints are only slightly enlarged. The fifth right foot of the *male* is very similar to that of *Centropages brachiatus*, but the second joint has only one uncinate process, and the last joint has one internal and two external marginal spines (fig. 8). The fifth foot of the *female* (fig. 9) is also like *Centropages brachiatus*, except that the spine of the median joint is slightly serrated, and projects downwards instead of at a right angle to the limb. The first segment of the *female* abdomen has no hooks, but is very tumid below. Caudal segments narrow, not divergent, about five times as long as broad. Eyes coalescent, single, indistinctly three-lobed.

Habitat.—*Centropages furcatus* was taken in the tow-net, off Port Jackson; in the Arafura Sea, September 13, 1874; and near the island of Mindanao, February 4, 1875. Prof. Dana's specimens were from the Straits of Banca.

3. *Centropages violaceus*, Claus (Pl. XXVII. figs. 1–14).

Ichthyophorba violacea, Claus, Die frei lebenden Copepoden, p. 199, pl. xxxv. figs. 13, 14.

Length, 1-11th of an inch (2·3 mm.). Cephalothorax elongated, cylindrical, narrowed towards the front and behind, posterior angles rounded off, internodes slightly constricted. Anterior antennæ (fig. 4) very slender, longer than the animal, gradually tapering from base to apex, twenty-four-jointed, fourteenth to nineteenth joints the longest, entirely destitute of spines, but clothed, especially towards the base, with slender setæ. The right anterior antenna of the *male* (figs. 2, 3) is but

slightly dilated in the middle; the joints on each side of the hinge bear delicately serrated marginal plates, and at the base of each plate there is a small spine. The terminal spines of the swimming feet are very slender, scarcely stouter than the marginal setæ. The outer branch of the fifth foot in the *female* (fig. 11) has its inner apical angle produced into a stout spine, which does not reach more than half the length of the third joint. In the *male* the fifth foot of the right side (fig. 12) is prehensile, the middle joint of the outer branch forming a robust, blunt, claw-like process, while the last joint bears at the apex a long, slender, doubly-curved, or S-shaped claw; the left foot has the last joint of its outer branch (fig. 13) distorted at the extremity, where it bears three short spine-like setæ. The abdomen in the *male* is elongated, but in the *female* short and stout; the caudal segments are flattened, slightly divergent, and scarcely twice as long as broad; setæ six, subequal, stout, shorter than the abdomen; in the *female* (fig. 14) the place of the second seta—counting from the outside—is usually occupied by a stout club-shaped appendage.

Habitat.—Off Cape Howe, Australia; off the Philippine Islands; Pacific, east of Japan, lat. 30° 22′ N., long. 154° 56′ W. (Station 256); South Pacific, October 18, 1875 (near Station 287); Atlantic, lat. 40° 3′ S., long. 132° 58′ W. (Station 288); lat. 42° 43′ S., long. 82° 11′ W. (Station 302); lat. 37° 3′ S., long. 44° 17′ W. (Station 326); lat. 37° 31′ S., long. 36° 7′ W. (Station 329); lat. 9° 43′ S., long. 13° 51′ W. (Station 342); North Atlantic, lat. 26° 21′ N., long. 36° 6′ W. In many of these places the species occurred in considerable abundance, showing a very extensive range of distribution, from the Mediterranean on the north to the coast of Patagonia southward, and to Japan, the Philippine Islands, and Australia in the east.

Dr. Claus describes his *Ichthyophorba violacea* as being violet-coloured with red spots. Such a description would perhaps not inaptly apply to the Challenger specimens when fresh, and I am the more inclined to suppose so, as the spirit specimens may be very readily separated from the bulk of the gatherings in which they occur by the presence of a cloudy purplish-brown patch on the body of each. This very probably represents the more diffused colouring of the living animal after being acted on by preservative fluid. The other points of Dr. Claus' description accord perfectly with our specimens, except as to the left fifth foot of the male, in which I find three terminal setæ instead of only two. The peculiar setose armature of the caudal segments in the female is not noticed by Dr. Claus.

Calanopia, Dana.

Calanopia, Dana, in part, 1852.

Anterior antennæ eighteen-jointed, that of the right side in the male geniculated, provided with two denticulated plates, and somewhat angulated at the flexures. Mouth-

organs generally as in *Pontella;* apical portion of the posterior foot-jaw six-jointed. Inner branches of the swimming feet two-jointed. Fifth pair of feet in both sexes consisting of one branch only. Abdomen of the female two, of the male five-jointed. Rostrum cloven; eyes two, small, closely approximated, near the base of the rostrum.

The smaller number of joints in the anterior antenna, and the unbranched character of the fifth pair of feet in both sexes are perhaps characters sufficiently important to warrant the retention of the generic name originally applied by Dana to this species, though on different grounds. Dana describes two sets of eyes, an inferior and superior, both very minute. In my spirit specimens I have been able to detect only the superior.

1. *Calanopia elliptica*, Dana (Pl. XXXIV. figs. 1–9).

Calanopia elliptica, Dana, Crust. U. S. Expl. Exped., p. 1132, pl. lxxix. fig. 6, *a.b.*

Length, 1-14th of an inch (2 mm.). Cephalothorax elongated, ovate, tapering and rounded off in front, posterior lateral angles sharply spined; anterior antennæ (fig. 2) slender, about as long as the cephalothorax, eighteen-jointed, third and sixth joints extremely short, tenth, eleventh, twelfth, and thirteenth long and slender; sparingly setose towards the apex, more densely on the proximal half; the principal serrated plate placed on the proximal side of the hinge (fourteenth joint); armature consisting of very fine, closely-set setæ (fig. 4). The upper half of the fifteenth joint is also very faintly pectinated, the serrations not being visible except with a high power of the microscope. Last joint of the right fifth foot in the *male* (fig. 7) stout and claw-like, its basal portion expanded, concave margin very irregularly rugose and dentated; terminal joint on the left side simple, cylindrical, marginally setose near the apex, bearing two apical and three lateral spines, the outer angle of the penultimate joint produced into a strong spine. Fifth pair of feet in the *female* simple, elongated, cylindrical, penultimate joint bearing a strong apical spine, last joint with three ciliated spines. The second segment of the *male* abdomen is produced on the right side into an acute angle, the last joint is extremely short; the caudal stylets about thrice as long as broad and more than equal in length to the last two abdominal segments; the two central tail setæ much longer than the rest,—about equal to the length of the abdomen.

Habitat.—Off Sibago Island, Zebu Harbour, and at other points off the Philippine Islands. Mr. Dana's specimens were taken in the Straits of Banca, east of Sumatra.

Pontellopsis, n. gen.

Head distinctly separated from thorax; abdomen of female two-jointed (?), and having a pouch-like protuberance on the left side. Anterior antennæ eighteen-jointed;

primary branch of posterior antenna three-jointed; secondary branch small, indistinctly four-jointed; mandible-palp composed of a moderately large basal joint, and two small branches composed of several joints; maxillæ and foot-jaws nearly as in *Pontella*. Inner branch of first swimming foot three-jointed, those of the following pairs two-jointed; fifth pair of feet two-branched. Eyes coalescent at base of rostrum.

This genus differs from *Calanopia* in the structure of the posterior antennæ, mandible-palp, first and fifth pairs of feet, and in the peculiar outgrowth of the abdomen. From *Pontella* it is separated by the less numerously jointed anterior antennæ, and especially by the characters of the posterior antennæ and mandible-palp. But no males having been observed, the generic characters here given must be taken as merely provisional.

The two species described by Dana as *Pontella pulchra* and *Pontella emeritu*, would appear to be nearly allied to that here noticed; but without fuller details it is impossible to say whether they really belong to the proposed new genus.

1. *Pontellopsis villosa*, n. sp. (Pl. XXXV. figs. 14–20, and Pl. XXXIV. figs. 10–13).

Length, 1-8th of an inch (3 mm.). *Female.*—Cephalothorax elongated, cylindrical, posterior angles produced into long, almost straight spines. Anterior antennæ (Pl. XXXV. fig. 15) eighteen-jointed, shorter than the cephalothorax, seventh and eighth joints coalescent and slightly swollen at the apex, all the joints bearing apical and marginal setæ of moderate length. Primary branch of the posterior antenna (Pl. XXXIV. fig. 10) three-jointed (sometimes indistinctly so); secondary branch very short, four-jointed, the two apical joints very small. The mandible is stoutly toothed and clothed with fine hairs toward the apex; palp two-branched, one branch composed of two, the other of five joints. Inner branch of the first swimming foot (Pl. XXXV. fig. 17) three-jointed, all the marginal spines of its outer branch very long and slender. The second, third, and fourth feet have two-jointed inner branches (fig. 18), the marginal spines of the outer branches ciliated, those of the first and second joints very long. Fifth pair of feet (*female*) two-branched (fig. 19), each branch consisting of a single joint, the inner very short, with furcate apex, the outer very much longer, bearing several spine-like setæ, three at the apex and two or three on the sides. Abdomen (fig. 20) two-jointed (?), produced at the distal extremity of the left side into a curious cushion-like villous protuberance, with a few terminal spines; caudal segments about twice as long as broad, setæ subequal; integument of the abdomen clothed with short hairs.

Habitat.—Lat. 30° 22′ N., long. 154° 56′ W. (Station 256); Atlantic between lats. 37° and 38° S., and long. 45° to 48° W.

Three specimens only were found in these gatherings, all females.

Sub-family 2. *Pontellinæ*, Dana.

In this sub-family there are two or more paired lateral sessile eyes, in addition to a large median eye, which is situated near the base of the rostrum, and is more or less prominent, and covered by an excessively convex lens.

Pontella, Dana.

Pontia, Milne-Edwards, Hist. Nat. des Crust., 1828.[1]
Pontella, Dana, Amer. Journ. Sci., 1846.
„ Claus, Die frei lebenden Copepoden, 1863.
„ Brady, British Copepoda, 1878.
Pontellina, Claus (in part), Die frei lebenden Copepoden, 1863.
Monops, Lubbock, Ann. and Mag. Nat. Hist., 1853.
Labidocera (*Iva*, *Ivella*), idem, ibidem, 1853.

Head distinct from the thorax, fourth and fifth thoracic segments coalescent. Abdomen of the male five- (sometimes three- or four-) of the female two- or three-jointed. Anterior antennæ twenty-one to twenty-four-jointed; sixth and seventh joints either coalescent or distinct; right antenna of the male more or less swollen in the middle from the thirteenth to the sixteenth, and hinged (usually) between the nineteenth and twentieth joints; seventeenth, eighteenth, and nineteenth united into one long joint which bears a serrated plate on its inner margin, twentieth and twenty-first joints also coalescent and serrated. Posterior antennæ bearing a large secondary branch. Mandibles well-developed, strongly toothed at the extremity, and bearing a palp composed of a large basal joint and two short branches. Maxillæ well-developed, composed of a broad, prehensile, or chewing portion, and a large three-lobed palp. Anterior foot-jaw robust, with strongly plumose setæ; basal portion of the posterior foot-jaw stout, divided at the apex of the inner margin into three (often indistinct) digits, which bear about six strongly plumose setæ; apical portion much more slender, elongated, four-jointed, setiferous.[2] Inner branches of all the swimming feet (except occasionally the first) two-jointed. Fifth pair of feet in the male adapted for clasping, that of the right side usually larger than the left. Lower eye stalked; two upper eyes often coalescent, composed of numerous refracting bodies, with two large, simple, more or less closely approximated lenses.

Dana (1852) has proposed to divide the genus *Pontella* into three sub-genera, characterised as follows:—

"1. *Calanopia*.—Including the Calanoid Pontellæ, in which the anterior antennæ are situated as in *Calanus*, with the tips not anterior to the line of the front; the anterior

[1] This generic name, though prior in date, is discarded, having been already used by Fabricius for a genus of *Lepidoptera*.

[2] The details of the mouth-organs, &c., given in Pl. XXXIX. (*Pontella kröyeri*) represent the typical generic structure.

branch of the posterior antennæ have but three setæ at the apex; the inferior eyes are quite small. This sub-genus may include some species referred to *Hemicalanus*.

"2. *Pontellina*.—Antennæ of second pair having five setæ at the apex of the anterior or smaller branch; head either side unarmed.

"3. *Pontella*.—Antennæ as in the last; head either side armed with a reversed spine. The *Pontia atlantica* of Edwards is of this kind. In this division the second of the caudal setæ is considerably longer (one-fourth at least) than the others (in most, if not all cases), which is not true of the preceding sub-genus *Pontellina*."

Again, Sir John Lubbock[1] has proposed two new genera—*Labidocera* and *Monops*—with three sub-genera, *Labidocera*, *Ivella*, and *Iva*. The generic and sub-generic definitions are as follows:—

"*Labidocera*.—Rostrum furcatum; antenna antica maris dextra geniculans, tumida, lamellis lobulisve dentatis instructa. Oculi superiores duo. Oculi inferiores nulli? Cephalothorax 7-articulatus. Pes posticus maris dexter, prehensilis. Abdomen maris 4-articulatum, feminæ 2-articulatum.

"Sub-genera:—1. *Labidocera*.—Antenna antica maris dextra duabus serratis lamellis instructa. Spina prehensilis, parva, rigido crini similis. Pes thoracicus quintus sinister, parvus, ramum internum 2-articulatum, ad apicem annulatum gerens. 2. *Ivella*.—Antenna antica maris dextra tribus dentatis lobulis instructa. Spina prehensilis, magna. Pes thoracicus quintus sinister, magnus, fortis, ad apicem acutus et corneus, ramum internum non gerens. 3. *Iva*.—Antenna antica maris dextra quatuor dentatis lamellis instructa, tumidissima. Spina prehensilis, maxima, annulata. Pes thoracicus quintus sinister, magnus, ad apicem tumidus, papillosus.

"*Monops*.—Rostrum furcatum. Antenna antica maris dextra geniculans, tumida. Oculi superiores nulli. Oculus inferior unicus. Pes posticus maris dexter crassus prehensilis."

The characters, however, upon which these divisions are based, though useful as affording specific distinctions, utterly break down when applied to larger groups. It has been already shown that Dana's two species of *Calanopia* belong really to distinct genera, and would scarcely have been brought together if the characters of the mouth-organs and feet, as well as the eyes and antennæ, had been taken into account.[2] For the same reason, Sir John Lubbock's genera and sub-genera appear to me quite untenable. The restriction of the generic term *Pontellina* as proposed by Dr. Claus, to species having a rostral lens, lateral upper eyes, lateral spines on the head, and a six-jointed apex to the posterior foot-jaw, will, I suspect, also be found impracticable; at any rate if the subordinate character of a three-jointed inner branch to the first foot is to be taken in

[1] *Ann. and Mag. Nat. Hist.*, March, August, and September 1853.

[2] It will be seen that though I adopt this term *Calanopia* for a genus of which *Calanopia elliptica*, Dana, is the type, I depend for its diagnosis on characters entirely distinct from those originally proposed.

conjunction with the rest. Amongst the Challenger species it will be seen that the six-jointed apex occurs not infrequently with a two-jointed inner branch of the first foot, though, as regards the character of the eyes, I am not able to speak certainly, owing to the action of spirit on the specimens.

*** Head without lateral spines; apex of posterior foot-jaw four-jointed.**

1. *Pontella acuta*, Dana (Pl. XXXVI. figs. 1–12).

Pontellina acuta, Dana, Crust. U. S. Expl. Exped., p. 1150, pl. lxxx. fig. 12, *a.–c.*

Length, 1-6th of an inch (4·2 mm.). Cephalothorax stout, cylindrical, posterior angles strongly produced and spined, that of the right side in the *male* twisted (fig. 10); head transversely sulcate in the middle, rostrum trifid, the two lateral segments larger and curved slightly downwards, the central standing straight up, so as to appear single when seen in front or behind. Anterior antennæ (fig. 2) twenty-one-jointed, rather longer than the cephalothorax, densely setose towards the base; that of the right side (fig. 3) in the *male* has the central joints considerably swollen; the two denticulated plates produced at the extremities, teeth short and stout (figs. 4, 5), those of the upper plate acute, of the lower squared at the apices. Inner branches of all the swimming feet two-jointed. The terminal spines of the swimming feet are somewhat dagger-shaped, and have a wide pellucid outer border, which is very minutely pectinated; the marginal spines short, lancet-shaped, with pellucid, finely pectinated edges. Fifth pair of feet in the *female* two-branched (fig. 9), both branches one-jointed, the outer twice as long as the inner, with three strong spines on the outer margin, and three at the apex; inner branch divided apically into two teeth. The fifth feet in the *male* (fig. 8) are unbranched, that of the right side having the first two joints long and simple, the following joint fan-shaped, and ending in a large pear-shaped claw; the three joints of the left side are nearly simple, the third bearing three or four curved apical claws, and a stouter one on the outer margin; the inner margin is fringed with delicate hairs. Abdomen of the *female* three-jointed, of moderate length, not quite half as long as the cephalothorax, last joint about equal in length to the caudal stylets; last joint of the *male* abdomen scarcely half as long as the stylets. The first abdominal somite bears at the apex of the right margin two spine-like processes, one of which in the *female* is very large (fig. 11). Caudal segments about twice as long as broad; setæ subequal, shorter than the abdomen. In the *female* the basal halves of the second, third, and fourth setæ (counting from the outside) are much dilated (fig. 12), the dilated portion of the second gradually tapering away, those of the third and fourth ending abruptly; all the setæ in their slender portions are densely plumose; those of the *male* are all spathulate towards the base, but not abruptly dilated as in the *female*. The anterior eyes are

situated near the base of the rostrum; in the *female* they are of moderate size and distant; in the *male* large and closely approximated.

Habitat.—Off Port Jackson, Australia; off Sibago Island and in other places amongst the Philippine Islands, and in the Arafura Sea, September 13, 1874.

Though Prof. Dana passes without notice the peculiar tail setæ and remarkable trifid beak of this species, many of the other characters figured and described by him as pertaining to *Pontellina acuta* (as, for instance, the fifth foot of the male and the twenty-one- and twenty-two-jointed antennæ) are so peculiar and so exactly similar to those of the specimens now under consideration, that it seems almost certain that the species referred to in both cases are the same. The two lateral spines of the rostrum, though large, may easily be overlooked in certain positions of the animal. Dana's measurement, 1-10th of an inch, is much less than mine, but a similar discrepancy occurs in many other cases. Dana's specimens, like ours, were obtained in the Eastern Seas:—"East Indies, off the south-east end of Mindoro, and in the China Sea." It should be noted that, owing to the position in which the animal is drawn, the eyes in fig. 1 do not appear so far distant as they ought to do.

2. *Pontella detruncata*, Dana (Pl. XXVI. figs. 8–15; Pl. XLV. fig. 20).

Pontellina detruncata, Dana, Crustacea, U. S. Expl. Exped., p. 1143, pl. lxxx. fig. 7, *a.–i.*

Length, 1-8th of an inch (3 mm.). Head subtruncated and obscurely angular in front, posterior angles of the cephalothorax rounded off or angular, not produced into long spines; rostrum furcate, of moderate length. Anterior antennæ twenty-two-jointed, densely clothed externally with long setæ towards the base, and on the inner aspect in the same region fringed with numerous delicate hairs (fig. 8); the right anterior antenna of the *male* (figs. 9, 10, 11) is much swollen in the middle, and bears three denticulated plates, the uppermost and lowest having produced, rounded, and thickened extremities; the denticulations of all three plates differ somewhat in character, those of the upper plate being slender and recurved and graduated in length from the middle to each extremity; in the middle plate the teeth are straight and sharp, each set upon a distinct, enlarged base, while those of the last plate are short, stout, and triangular. Inner branches of the swimming feet all two-jointed, spines as in the preceding species, but rather more slender. Fifth pair of feet in the *male* (fig. 13) one-branched; first two joints of the right limb simple, third joint produced at the basal angle into a stout, claw-like prominence, and armed at the apex with a long, slender, curved claw, which bears three slender marginal setæ; the left limb is simple, but is provided at the apex with four slender, curved, claw-like appendages, and has its margin finely setose. Fifth pair of the *female* (fig. 12) almost rudimentary, cylindrical, slightly denticulated at the apices; the penultimate joint bears an internal branch composed of

one minute joint. The last joint of the abdomen is in both sexes (figs. 14, 15) very small, shorter than the caudal stylets, which are about as broad as long; terminal setæ subequal, as long as the abdomen, and alike in both sexes. Eyes three, the upper pair large and closely approximated.

Habitat.—Pacific, 400 miles south of Hawaii, and north of the Sandwich Islands, moderately abundant; Atlantic off Buenos Ayres; and off St. Vincent, Cape Verde.

The type specimens of this species were taken in various parts of the Pacific, and are evidently identical with those here described. Dana's figures of the female fifth foot, however, do not agree with mine, nor, as usual, do our measurements coincide, the length of the types being given as 1-12th to 1-16th of an inch. The colour is said by Dana to be, like most of the *Pontellæ*, bluish; but this I have no means of confirming, spirit specimens only having come under my notice.

3. *Pontella acutifrons*, Dana (Pl. XXXV. figs. 1–13).

Pontellina acutifrons, Dana, Crustacea, U. S. Expl. Exped., p. 1149, pl. lxxx. fig. 11, *a.–h.* (1852).

Pontella bairdii, Lubbock, Ann. and Mag. Nat. Hist., second series (1853), vol. xii., p. 117, pl. v. figs. 1–6.

? *Pontia edwardsii*, Kröyer, Nat. Hist. Tidskr., 2 Række, Bind ii. (1846–9), p. 599, pl. vi. figs. 8–11.

Length, 1-6th of an inch (4·2 mm.). Cephalothorax elongated, cylindrical, tapering towards each extremity, posterior lateral angles produced and acutely angular, head pointed in the middle, transversely sulcate, rostrum of moderate length and furcate. Anterior antennæ as long as the cephalothorax (fig. 3), twenty-four-jointed, third to twelfth joints densely clothed with long hairs on the outer and finely setose on the inner margin; right antenna of the *male* (figs. 4–7) moderately swollen in the middle, two denticulated plates terminating above and below in very long free extremities; the upper of those curved processes bites against a small tooth attached to the base of the preceding antennal joint (fig. 6); inner branches of all the swimming feet two-jointed; marginal spines of the outer branches lancet-shaped and duplicated (fig. 8), terminal spines as in *Pontella detruncata*. Fifth pair of feet in the *male* (fig. 10) having the third joint of the right side irregularly quadrate, and produced at the base so as to form an immovable claw, bearing at the apex a stout subpyriform claw; the basal joint of the left side has a peculiar twisted and laciniated appendage (penis?); the terminal joint finely setose and bearing two small apical claws. Fifth pair of feet in the *female* (fig. 9) simple, last joint elongated and trifid at the apex, penultimate joint bearing a rudimentary one-jointed internal branch. The first segment of the *female* abdomen (fig. 12) is usually very tumid, the caudal segments not much longer than broad, and often much projected laterally (perhaps a distortion), that of the right side bearing two spines on

its outer margin, and having the three outer setæ dilated and spathulate at the bases. The setæ are all nearly equal in length; those of the left segment are not spathulate, nor are any of those of the *male* animal. The upper eyes are closely approximated, larger in the *male* than in the *female*.

Habitat.—Off Port Jackson, Australia; abundantly between Api and Cape York; Philippine Islands (February 6, 1875); abundantly in the Pacific, north of the Sandwich Islands; in several gatherings from the North Atlantic near the Cape de Verde Islands, and near the Ki Islands, Australasia. This appears to be one of the commonest and most widely-distributed of the *Pontellæ*, and there can be no doubt, I think, of the identity of the species described separately by Prof. Dana and Sir John Lubbock.

4. *Pontella plumata*, Dana (Pl. XXXVII. figs. 1–11).

Pontellina plumata, Dana, Crustacea, U. S. Expl. Exped., p. 1135, pl. lxxix. fig. 10, *a.–d.*
„ *turgida*, ♂, idem, ibidem, p. 1136, pl. lxxix. fig. 11, *a.b.*, fig. 12, *a.b.*

Length, 1-12th of an inch (2·1 mm.). Cephalothorax of the *female*, seen from above, very broadly ovate, scarcely twice as long as broad, rounded off in front, posterior lateral angles rounded or scarcely angulated, rostrum slender, adpressed; figure of the *male* rather less tumid. Anterior antennæ (fig. 2) about as long as the body of the animal, twenty-one-jointed (?), slender, sparingly setose, most of the joints bearing one or two small apical and marginal setæ, and several of them—notably the fourth, fifth, sixth, thirteenth, fourteenth, fifteenth, eighteenth, and twentieth, having also single long ciliated setæ, the last joint having four long terminal setæ of the same character; the central joints of the right antenna in the *male* (fig. 3) are very much and abruptly swollen, the first of the swollen joints bearing a rigid, geniculated seta, the last a strong tooth and a series of fine marginal setæ; the limb beyond this point—being at least half its length—is divided into three very long and slender joints, the first of which is finely setiferous or denticulated throughout its entire length, while the next joint bears a short, sub-crescentic series of about twelve similar setæ on its upper half; between these two joints the antenna is hinged. The setæ of the posterior antennæ in the *female* (fig. 4) are profusely plumose, remarkably long, and reaching, in the natural position of the limb, nearly, if not quite to the extremity of the body of the animal (fig. 1); the secondary antennal branch is about half as long as the primary. The two branches of the mandible-palp are respectively two- and three-jointed (fig. 5), and their setæ are also extremely long. Posterior foot-jaw very small. The first pair of swimming feet (fig. 6) has its inner branches three-jointed, the outer marginal spines very slender; the terminal spines of the following pairs of feet (fig. 7) are straight and narrow, with finely pectinated margins. In the *male*, the fifth foot (fig. 9) of the right side has the third joint broadly quadrate, with a strong, falcate, lateral process, the terminal claw

very stout and bent almost rectangularly; the foot of the left side is simple, its last joint bearing a few small apical setæ. The fifth pair in the *female* are very slender (fig. 8), the penultimate joint giving attachment to two slender, one-jointed branches, the inner short and bearing two small apical setæ, the outer about thrice as long, with one marginal and four long apical setæ. Abdomen of the *male* five-jointed (fig. 11), its third joint with a large protuberance on the right side; caudal segments rather longer than broad, setæ five, equal. In the *female* there are six non-spathulate tail setæ (fig. 10), the second, counting from the inside, thinner than the rest and not ciliated.

Habitat.—Off Port Jackson, Australia; between Api and Cape York; between Arrou and Banda; off Kandavu, Fiji; off the north of Papua; off the Philippine Islands; and off St. Vincent, Cape Verde.

This seems to be one of the most widely distributed of the pelagic Entomostraca, though seldom or never occurring in very large numbers. Prof. Dana gives a long list of localities in which he found it, and I do not doubt that the form named by him *Pontellina turgida* is referable to the male of *Pontellina plumata*. It is remarkable that the setæ of the mandibles and antennæ, which, on account of their length and dense ciliation, form so unique a feature in the female, are of no great length and scarcely at all plumose in the male.

**** Head with lateral spines; apex of posterior foot-jaw four-jointed.**

5. *Pontella lævidentata*, n. sp. (Pl. XXXVIII. figs. 1–6).

Length, 1-15th of an inch (1·6 mm.). Cephalothorax elongated, cylindrical, posterior angles spinous, that of the right side doubly spined; sides of the head produced near the front into two recurved spines. Right anterior antenna of the *male* (figs. 2 and 3) only moderately swollen, one joint on each side of the hinge provided with a minutely serrated marginal plate; at the proximal extremity of the upper and distal extremity of the lower plate is a long, adpressed, curved spine, pointing towards the apex of the antenna. Swimming feet slender, with very slender terminal spines. Fifth pair of feet of the *male* (fig. 5) one-branched, that of the right side doubly hooked, that of the left terminating in three unequal, crooked spines, the longest of which (fig. 6) has a villous enlargement at the base.

Habitat.—Taken off Sibago Island, Philippines, October 23, 1874. One specimen only was found, and the structure of the lower foot-jaw was not accurately noted.

6. *Pontella krŏyeri*, n. sp. (Pl. XXXIX. figs. 1–19).

Length, 1-11th of an inch (2·3 mm.). Cephalothorax robust, lateral posterior angles forming stout triangular acuminated processes. Anterior antennæ (fig. 2) twenty-three-

or twenty-four-jointed, longer than the cephalothorax, the basal joints very indistinctly separated, rather sparingly setiferous; right antenna of the *male* (fig. 3) having two denticulated joints, the proximal end of the first plate forming a free sub-crescentic or club-shaped process, which bears a series of broad recurved teeth, following which is a row of six or seven still larger spines, graduated in size from the middle, where they are longest; the teeth of the main portion of the plate, as also those of the following joint, are very fine and close-set; the antepenultimate joint is produced externally into a dagger-shaped, adpressed spine, equal in length to the penultimate joint. The joints of the right fifth foot in the *male* (fig. 11) are all broad and subquadrate, the third bearing a long curved terminal claw, and a similar immovable finger at its upper angle; the third joint of the left side has two apical spine-like setæ, and two small roughened or tuberculated finger-like papillæ (figs. 12 and 13). The fifth foot in the *female* (fig. 10) has a broad quadrate basal joint, to which are attached two simple, curved, one-jointed branches, the inner only half as long as the outer. The abdomen of the *male* (figs. 18, 19) is five-jointed, and sometimes has the ventral angle prominently spined; the *female* abdomen is two-jointed (figs. 14–17), and usually has the lower margins of the segments irregularly fimbriated or spinous; the first segment has also on the ventral aspect three or four slender curved processes of variable size. The second tail seta, counting from the inside, is usually longer than the rest.

Habitat.—Arafura Sea, lat. 8° S., long. 136° E.; off Sibago Island and at other places amongst the Philippine Islands.

This species—unless two or three are here mixed up under one specific name—is subject to a good deal of variation, especially in the peculiar distortions or outgrowths of the abdominal somites, some of which are figured in our plate; the fifth pair of feet, also, in both sexes, presents minor variations of form.

Several species very nearly allied to this have been described by different authors, but none of them seem to admit of complete identification with it. Among its very near relatives may be mentioned *Pontella strenua* and *Pontella valida*, Dana; *Pontella helgolandica* and *Pontella gigantea*, Claus, and *Labidocera darwinii*, Lubbock.

***** Head with lateral spines; apex of posterior foot-jaw six-jointed.**

7. *Pontella elephas*, n. sp. (Pl. XXXVIII. figs. 7–14).

Length, 1-8th of an inch (3 mm.). Cephalothorax pointed in front, with recurved spines on each side of the head, posterior angles rounded off. Anterior antennæ shorter than the cephalothorax, twenty-three-jointed (fig. 8), densely setiferous towards the base, more sparingly beyond. Right anterior antenna of the *male* (fig. 9) thick and short; the teeth of the one denticulated plate (figs. 10, 11) are short and stout, and blunt at the

apices; the two joints on the proximal, and one on the distal side of the prehensile plate, are armed with curiously flexuous, blunt, spine-like processes, and some of the ordinary setæ are ringed. The fifth pair of feet in the *male* (fig. 13) are small, the last joint of the right side quadrilateral, and bearing two long falcate claws; that of the left side has a few short blunt apical claws. In the *female*, the fifth foot (fig. 12) has two terminal branches, the inner minute, awl-shaped, and sometimes bearing a slender hair at the apex, the outer much longer and having four marginal spines. The abdomen of the *female* is two-jointed, the first joint very large (fig. 14), and having two lateral protuberances; the caudal setæ are subequal, about as long as the abdomen; in the *male* one of the setæ of each side is much longer than the rest.

Habitat.—Only very few specimens of this species were observed in gatherings from off Sibago Island, and other localities in the neighbourhood of the Philippine Islands. I cannot identify these with any described species. It may be noted that the jointing of the basal part of the anterior antennæ is often very indistinct, as in other species of *Pontella;* in some specimens I cannot count more than eighteen or nineteen joints, nor does this seem to depend upon immaturity.

8. *Pontella strenua*, Dana (Pl. XLV. figs. 16–19).

Pontellina strenua, Dana, Crust. U. S. Expl. Exped., p. 1158, pl. lxxxi. fig. 4, *a–d.*

Male.—Posterior thoracic angles acutely produced, that of one side much longer than the other; abdomen five-jointed; superior eye large, and situated in the base of the rostrum, inferior two in number, small, remote, and a little behind the base of the rostrum. The joints immediately above and below the geniculation of the right anterior antenna are provided with strongly pectinated marginal plates, which do not form excurrent projections; near the extremity of the distal pectinated plate there is, however, a simple slightly curved spine (fig. 16). The terminal spines of the swimming feet are long and slender, and not so finely pectinated as usual in the genus.

Specimens which I refer to this species were taken between Sydney and Wellington, and at night in the South Atlantic, October 5, 1873, near lat. 28° S., long. 30° W. The animals were not perfect, and differed slightly in some particulars, probably dependent on age, as for instance in the shape of the abdomen, two forms of which are shown in figs. 18 and 19.

9. *Pontella inermis*, n. sp. (Pl. XLV. figs. 10–15).

Length, 1-5th of an inch (5 mm.). Head separate and acutely pointed in front, produced behind into two small backward-pointing lateral spines; eyes two, not very widely separated; posterior thoracic angles acute, but not greatly produced (fig. 10).

Abdomen of the *male* (?) four-jointed. Anterior antennæ twenty-three-jointed on the right, twenty-four-jointed on the left side, very sparingly setose (figs. 11, 12), the joints indistinct towards the base, the seventeenth and eighteenth joints of the right side are longer than the neighbouring joints, and the eighteenth bears at its apex a not very long and simple spine, but there is no distinct geniculation or serratures. The marginal spines of the swimming feet (fig. 14) are simple, the terminal ones dagger-shaped and minutely pectinated. The fifth pair of feet are simple, last branch three-jointed, terminal joints bearing short marginal spines.

This species, of which I have seen only two examples, was taken off Ascension Island (Station 344). Except for the swollen and spiniferous right antenna, I should probably have set them down as females, the characters of the fifth pair of feet being such as are commonly found in that sex. There is an appearance of immaturity in the indistinct jointing of the anterior antennæ, but the size of the animal and the full development of the swimming feet do not support that idea. On the whole it seems best to assign the specimens a distinct specific name.

10. *Pontella securifer*, n. sp. (Pl. XLV. figs. 1–9).

Right anterior antenna (fig. 1) of the *male* very tumid in the middle (ninth, tenth, and eleventh joints), the ninth bearing a long and stout spine, the twelfth a hatchet-shaped process, its outer margin bordered with a serrated plate, thirteenth joint simple, fourteenth with a marginal pectinated plate, last joint (fourteenth) very long and slender; a geniculation between the twelfth and thirteenth joints. Inner branch of the first pair of swimming feet three-jointed,—of the second, third, and fourth pairs two-jointed in both sexes. Abdomen of the *male* three- (fig. 7), of the *female* (figs 8, 9) two-jointed, very short, and curiously distorted. Rostrum and eyes (figs. 2, 3) as in *Pontella strenua*.

I have seen only two or three specimens from a gathering made in Mid-Pacific, August and September 1875.

11. *Pontella magna*, Lubbock.

Labidocera magna, Lubbock, Ann. and Mag. Nat. Hist., ser. 2, vol. xi. (1853), p. 208, pl. x. figs. 8–11.

A few specimens occurred in a gathering from the South Atlantic (lat. 37° 38′ S., long. 39° 36′ W.). Sir John Lubbock's specimen was also from the South Atlantic, lat. 18° 40″ S., long. 2° 30″ W.

Family II. Cyclopidæ, Baird (in part).

Body elongated, in general outline similar to that of the Calanidæ; anterior antennæ of moderate length, rarely longer than the cephalothorax; those of the males alike on both sides, and geniculated for clasping; posterior four-jointed, and without a secondary branch. Mandibular and maxillary palps well developed or occasionally rudimentary. Foot-jaws much like those of the Calanidæ. First four pairs of feet alike, two-branched, and adapted for swimming only; fifth pair rudimentary, alike in both sexes. Heart wanting. Eyes of the two sides coalescent in the median line. Ovisacs two.

The absence of an internal branch of the posterior antenna, the rudimentary character of the fifth foot, alike in both sexes, and, in the male the modification of both right and left anterior antennæ, to act as clasping organs, distinguish this Family from those already described, while, from the Harpacticidæ it is separated chiefly by the structure of the foot-jaws and first pair of swimming feet. Except the genus *Oithona*, no members of the Family have been observed in the Challenger gatherings.

Oithona, Baird, 1843.

Body much elongated, slender; head quite distinct from thorax. Anterior antennæ long and slender. Mandible-palp elongated, two-branched; secondary branch composed of several joints. Maxillæ stout, and provided with a short two-branched palp. First pair of foot-jaws long and slender, four-jointed (not unlike those of *Calanus*); second pair also as in *Calanus*, but indistinctly jointed. All the branches of the first four pairs of feet are three-jointed; fifth pair rudimentary, bearing two small setiferous papillæ.

This genus partakes of the characters both of the Cyclopidæ and Calanidæ, and is perhaps in general appearance more like *Acartia* (*Dias*) than any other genus; in this situation it was placed by Dana. But inasmuch as some of the most important features of the Cyclopidæ are present in *Oithona*, it seems best to consider it as belonging to that Family. The geniculated form of both anterior antennæ in the male, the absence of a secondary branch in the posterior antennæ, the very rudimentary form of the fifth pair of feet, and the presence of two ovisacs, are all characters in which it agrees with *Cyclops*. The structure of the internal organs also conforms to that of *Cyclops*.

Oithona challengerii, n. sp. (Pl. XL. figs. 1–10).

Length, 1-14th of an inch (1·8 mm.). Cephalothorax narrow, tapered towards the anterior extremity, and produced into a curved beak (fig. 2); abdomen nearly as long as

the cephalothorax, very narrow, and equal in diameter throughout its entire length, five-jointed, the various joints nearly equal in length. Anterior antennæ (fig. 1) composed of thirteen joints, of which the second and third and the last four are very short and nearly equal, the fourth, fifth, and ninth being the longest; the proportionate lengths of the joints are approximately as follows:—$\frac{1}{5}\ \frac{2}{2}\ \frac{3}{1}\ \frac{4}{5}\ \frac{5}{5}\ \frac{6}{5}\ \frac{7}{2}\ \frac{8}{2}\ \frac{9}{7}\ \frac{10}{1}\ \frac{11}{1}\ \frac{12}{1}\ \frac{13}{1}$. The limb bears about twelve very long and slender setæ. The maxilla (fig. 4) has a stoutly armed prehensile portion and a well-developed palp, to which is attached a trisetose branchial (?) plate. The first pair of swimming feet (fig. 7) has both branches three-jointed, the outer branch bearing a marginal series of small aculeated spines; the branches of the following three pairs are also three-jointed (fig. 8), but have no marginal spines. The terminal spines of all the feet are excessively long and slender, and are finely pectinated on the outer margin. The fifth foot (figs. 1, 9, 10) consists of a small tubercle, to which are attached two long biarticulate setæ. Caudal segments slightly divergent, nearly as long as the preceding abdominal segment, each bearing six plumose setæ, four of which are about as long as the abdomen; one of these arises from near the base of the external margin; two others—the innermost and outermost of the apical series—are much shorter than the rest.

Dana has described three species of *Oithona*, Claus two, and Boeck two, but none of these seem quite to agree with the form which occurs in several of the Challenger gatherings. The animal, however, is so fragile, and so difficult of examination, that it is quite possible that errors of observation may have affected the descriptions both of myself and other authors. But, so far as I can make out, the antennæ of this species are certainly thirteen-jointed. Dana assigns only seven joints to those of all his species, and I cannot but think that he must have failed to observe them correctly. Claus's species have respectively ten and twelve joints. The present species approaches most closely to *Oithona spinirostris*, Claus, and perhaps to *Oithona setiger*, Dana, but the differences are too considerable to allow of our safely referring it to either of these. Though examples of *Oithona* were noticed in very many of the surface-gatherings of the Challenger, I have not been able to recognise differences requiring their reference to more than one species. The form doubtfully referred in the general list of species (p. 5) to *Oithona spinirostris*, Claus, I cannot on re-examination distinguish from the present species.

Specimens which I refer to this species were found in the produce of the surface-net from the following localities:—Off the south of Papua; off Port Jackson, Australia; west of the Philippine Islands (Station 206); in Hilo Harbour, Sandwich Islands, abundantly; in lat. 42° 32′ S., long. 56° 27′ W. (Station 318); lat. 32° 24′ S., long. 13° 5′ W. (Station 335); lat. 12° 16′ S., long. 13° 44′ W. (Station 341); lat. 9° 43′ S., long. 13° 51′ W. (Station 342); in all the Stations between lat. 3° 10′ N., long. 14° 51′ W.; and lat. 10° 55′ N., long. 17° 46′ W. (Stations 348–352); and in lat. 26° 21′ N., long. 33° 37′ W. (Station 353).

Family III. HARPACTICIDÆ, Claus.

Body cylindrical, or occasionally depressed. Abdomen, in most cases, not sharply separated from the cephalothorax. Anterior antennæ short, composed of few (4–10) joints, and scarcely ever reaching beyond the posterior margin of the first body-segment; in the male adapted on both sides for clasping. Posterior antennæ two- to four-jointed, and provided with a small one- to four-jointed secondary branch. Mandibles strongly toothed; palp either simple, consisting of one or two joints, or more complex, and composed of a basal portion with two branches. Maxillæ usually well developed, consisting of a dentated cutting segment and a more or less complex palp, which is made up of several setiferous digits, arranged in a somewhat radiated manner. Anterior foot-jaws armed at the apex with several strong teeth, and on the inner margin with several (usually three) wart-like, setiferous processes. Posterior foot-jaw sometimes foot-like, but mostly in the form of a prehensile hand. First pair of feet mostly different from the following pairs, and converted into a prehensile apparatus; second, third, and fourth pairs adapted for swimming; fifth pair two-jointed, foliaceous, different in the two sexes, the basal joint usually dilated and embracing the smaller apical joint. Eyes as in *Cyclops*. Heart wanting, copulative organs in the female symmetrical, in the male usually asymmetrical. Ovisac single, or rarely double.

The number of Harpacticidæ taken during the cruise is very inconsiderable, belonging to eight different genera, and as many species. The genera represented are the following:—*Ectinosoma*, *Pseudothalestris*, *Zaus*, *Miracia*, *Machairopus*, *Pontostratiotes*, *Goniopsyllus*, and *Setella*; of these all but *Ectinosoma*, *Zaus*, *Miracia*, and *Setella* are new.

Ectinosoma, Boeck.

Ectinosoma, Boeck, Oversigt Norges Copepoder, 1864.

Body much elongated, slender; abdomen not separated from the thorax by any distinct constriction, and remaining unflexed on the body after death. Head small, united with the first thoracic segment. Anterior antennæ very short, much attenuated towards the apex, five- to seven-jointed, bearing numerous long setæ. Posterior antennæ much larger and stronger, three-jointed, and bearing on the first joint a long two- or three-jointed secondary branch; the last joint bears several strong, spine-like plumose hairs. Mandible slender, deeply cleft at the apex; palp large, two-jointed, bearing several long setæ, and a short, simple, secondary branch, which arises from the first joint. Basal joint of the maxilla strongly clawed, palp divided into numerous marginal setiferous lobes. Anterior foot-jaws two-jointed, broad, provided with two strong terminal claws and marginal setæ; posterior three-jointed, long and slender, second joint the longest. Four pairs of swimming feet, all nearly alike, two-branched, each branch composed of three nearly equal joints. Each foot of the fifth pair is composed of two angular setiferous laminæ.

Ectinosoma atlanticum (?) (Brady and Robertson), (Pl. IV. figs. 10–14).

Microsetella atlantica, B. and R., Ann. and Mag. Nat. Hist., ser. 4, vol. xii. p. 130, pl. ix. figs. 11–16 (1873).
Ectinosoma atlanticum, Brady, Monograph of the British Copepoda, vol. ii. p. 13, pl. xxxviii. figs. 11–19.

Length, 1-45th of an inch (·53 mm.). Body very slender, almost linear, much attenuated both behind and in front; tail-segments very short and divergent. First four pairs of feet long and slender (fig. 12), outer branches slightly shorter than the inner, each joint bearing a long, slender, apical spine, and pectinated on its outer edge; median joint only of the inner branch pectinated. Fifth pair of feet (fig. 13) rudimentary, two-jointed; internal portion of the basal joint produced nearly as far as the apex of the second joint, and bearing two apical setæ, one of which is very long; second joint smaller, and bearing two long and one or two very short setæ. Caudal segments bearing two principal setæ, one of which is longer than the body of the animal, the other about half as long. The posterior borders of the last three abdominal segments are finely and densely pectinated (fig. 14).

The foregoing imperfect description gives, with as much accuracy as could be obtained from observation of only a single specimen, the characters of the species. Though differing very slightly from those of *Ectinosoma atlanticum*, I cannot venture on such slender grounds to assign to this single example a new specific name. It was taken in the tow-net down to 200 fathoms, on the 9th of April 1876, in lat. 3° 10′ N., long. 14° 51′ W. (near Ascension Island).

Dr. Giesbrecht has recently[1] proposed to split up the genus *Ectinosoma*, leaving in it, if I rightly understand him, only one species, *Ectinosoma gothiceps*, Giesbrecht. But the grounds for this proposal are as yet given only in a very cursory way, and, so far as I can judge, are insufficient. Should the present species eventually be assigned to a different genus, the name *Microsetella* (withdrawn in the Monograph of the British Copepoda) must be reinstated.

Pseudothalestris, n. gen.

Like *Thalestris*, except as to the structure of the first pair of feet, in which the outer branch is very short and only two-jointed, the inner branch long, three-jointed, having the first joint very long, the second and third rudimentary.

[1] Vorläufige Mittheilung aus einer Arbeit über die frei lebenden Copepoden des Kieler Hafens *Zool. of Anzeiger*, No. 83, 1881.

Pseudothalestris imbricata, n. sp. (Pl. XLII. figs. 1–8).

Male.—Anterior antenna (fig. 1) eight-jointed, moderately setiferous, and provided with a long and stout olfactory filament. Inner branch of posterior antenna (fig. 2) small, two-jointed. Hand of the posterior foot-jaw (fig. 3) oval and armed with one seta on the inner margin, terminal claw long and slender. Peduncle of the first pair of feet (fig. 4) armed at the base of the inner branch with a crescentic series of stout teeth; first joint of the inner branch about five times as long as broad, setose on the outer and having a single seta near the middle of the inner margin; second and third joints together only about one-fifth as long as the first joint, terminal claw slender, nearly straight, more than half as long as the first joint, and marginally pectinate; outer branch two-jointed, with very stout marginal and terminal spines. Inner branch of the second pair (fig. 5) two-jointed, the second joint being composed of two coalescent joints; outer branch three-jointed, with very large and stout marginal spines. Both branches of the third and fourth pairs three-jointed (fig. 6). The fifth foot (fig. 7) has the two joints nearly equal in size, inner segment of the first joint with three moderately long, subequal, apical setæ; second joint quadrate, bearing five setæ, one of which is much longer than the rest. The joints of the abdomen (fig. 8) are short, and overlap very much at the sides. The longest of the tail setæ is about twice as long as the abdomen.

Only one specimen of this species was found, its characters being intermediate between those of *Dactylopus* and *Thalestris*. The second, third, and fourth pairs of feet agree closely with *Thalestris*, while the first foot, except as to the two-jointed outer branch, is very similar to the same limb in *Dactylopus*. The female has not been seen.

Habitat.—Betsy Cove, Kerguelen Island.

Zaus, Goodsir.

Zaus, Goodsir, Ann. and Mag. Nat. Hist., 1845.

Body broad and depressed; head distinct from cephalothorax, rostrum broad and truncated. Anterior antennæ nine-jointed; posterior two-jointed, secondary branch two-jointed. Mandibles strongly toothed, palp two-branched. First pair of feet two-branched, its outer branch two-jointed, twice as long as the inner; inner branch two-jointed, the second joint rudimentary; ovisac large, adpressed, single. Second, third, and fourth pairs of feet with both branches three-jointed; fifth pair foliaceous, two-jointed.

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Zaus spinatus, Goodsir (Pl. XL. figs. 12–16, and Pl. XLI. figs. 13–17).

Zaus spinatus, Goodsir, On several new species of Crustaceans allied to Saphirina, Ann. and Mag. Nat. Hist., vol. xvi. p. 326, pl. xi. figs. 1–8 (1845); Brady, Monograph of British Copepoda, p. 153, pl. lxvi. figs. 1–9 (1880).

„ *spinosus*, Claus, Die frei lebenden Copepoden, p. 146, pl. xxii. fig. 25, pl. xxiii. figs. 1–10 (1863); Boeck, Oversigt Norges Copepoder, p. 40 (1864).

This well-known European species needs no detailed description here. The specimens brought home by the Challenger were taken in Balfour Bay, Kerguelen Island, and differ in no respect from those found in Europe, except, perhaps, that the marginal cilia of the spines of the feet and posterior antennæ are somewhat less fully developed.

Zaus spinatus affords an interesting illustration of the close resemblance borne by the Kerguelen Island Entomostracan fauna to that of Northern Europe,—a matter already noticed in the preface.

Miracia, Dana.

Miracia, Dana, Proc. Amer. Acad. Sci., 1849.

Body subcylindrical; forehead produced into a short blunt rostrum. Anterior antennæ eight-jointed, short, in the male geniculated, but without any vesiculiform enlargement. Posterior antennæ two-jointed, and bearing a small single-jointed secondary branch. Maxilla toothed and broad at the apex, and provided with a small (one- or two-jointed ?) setiferous palp. Mandible composed of a toothed cylindrical segment, without a palp. Anterior foot-jaw small, divided into several small marginal setiferous processes. Posterior much larger, two-jointed, joints long and narrower, the last truncated at the apex and bearing a short falciform claw. Four pairs of feet adapted for swimming and non-prehensile; fifth pair foliaceous. Eyes very prominent, placed in the forehead, and covered with two confluent refracting lenses. Abdomen four-jointed in the female, five-jointed in the male.

Miracia efferata, Dana (Pl. XLIII. figs. 1–16).

Length, 1/12th of an inch (2·1 mm.). Integument tough; body slender, ten-jointed, with distinct constrictions between the several somites; abdomen nearly equalling the cephalothorax in length. Eyes composed of two large confluent and extremely prominent lenses, situated on the very front of the head (figs. 2, 16). Anterior antennæ shorter than the first body segment, eight-jointed; in the *female* (fig. 4) slender, and gradually tapering to the apex; the third, sixth, and eighth joints are the longest, nearly equal, and together make up half the length of the limb; the fifth and seventh joints are the shortest; each joint bears about two or three setæ of moderate length, and the fourth has a rod-like

olfactory filament; in the *male* (fig. 3) the antenna is geniculated, and has a slender claw-like apical joint. The posterior antenna (fig. 5) is two-jointed and cylindrical, the first joint having attached near the middle a minute one-jointed branch, which bears two stout pectinated setæ, the last joint about half as long as the first, and provided with four apical setæ of unequal length, and bearing also a small seta on the outer margin. Mouth-organs extremely minute. Mandible simple, cylindrical (fig. 7), obscurely toothed at the apex, and beset on one margin with a series of closely-set fine hairs. Maxilla (fig. 6) short, quadrate, truncated, and strongly toothed at the apex, bearing a small simple palp, which has a large marginal seta and three smaller apical ones. Anterior foot-jaw (fig. 8) short and stout, divided into several (about four) stout marginal setiferous digits; posterior (fig. 9) elongated, narrow, two-jointed; first joint bearing only a single small marginal hair, second truncated and serrated at the apex, which is armed with a short and stout hook-like claw; the first joint about five times, the second three or four times, as long as broad. The second, third, and fourth pairs of feet are nearly alike, and the same in both sexes (except the second pair of the *male*), having both branches three-jointed and of nearly equal length; the first pair is similar in *male* and *female* (fig. 10), and differs from the rest in having the inner branch composed of only two joints, and in being less profusely setose; the inner branch, too, is slightly longer than the outer; in the *male* the inner branch of the second pair (fig. 11) is two-jointed, the last joint being composed apparently of the coalescent second and third joints; fifth foot (figs. 13, 14) composed of two foliaceous joints, not very dissimilar in the two sexes, the basal joint fringed with four or five, the apical with six stout setæ. The first abdominal segment in the *female* is formed by the confluence of two somites, and shows a more or less distinct division into two parts, in the *male*, the first segment has the postero-ventral angle produced and setiferous (fig. 15); caudal stylets cylindrical, about thrice as long as broad; terminal setæ three, the longest being considerably shorter than the abdomen. The ovisacs of the *female* contain only a small number of very large ova.

Habitat.—Lat. 40° 3′ S., long. 132° 58′ W. (Station 288); and lat. 5° 28′ N., long. 14° 38′ W. (Station 349). In the first-named locality only one specimen, a male, was found; in the second several specimens, all of which were females. A few specimens were taken in Mid-Atlantic (Station 99), and mounted alive during the cruise, thus preserving the colours of the living animal,—the body a brilliant bluish-green, cornea smoky yellow; from all the spirit-specimens the colour has entirely fled.

I have not been able to find the "falciform appendages" described by Dana; probably these correspond to the blunt frontal prominence which I call the rostrum. Except in the relative lengths of the antennal joints, the Challenger specimens agree closely with Dana's description of *Miracia efferata*, the anterior antenna of which is said to be seven-jointed, the third, fifth, and seventh joints being the shortest. I cannot at all explain the discrepancy, and possibly the two may prove to be distinct; but for the

present, it seems best to keep them under one specific name. One of the localities given by Dana corresponds pretty nearly with the Challenger Station No. 349.

Machairopus,[1] n. gen.

Cephalothorax broad and rather depressed; abdomen five-jointed in both sexes. Anterior antennæ nine-jointed; inferior three-jointed, with a large three-jointed inner branch. Mandible strong, and provided with a slender two-branched palp. Maxilla (?). Foot-jaws three-jointed, the second pair uncinate and flexed in a geniculated manner. Inner branch of the first pair of feet two-jointed, armed at the extremity with two broad laminated or knife-like appendages in place of claws; outer branch short, three-jointed, and strongly setiferous, second, third, and fourth pairs having both branches three-jointed; fifth pair foliaceous, two-jointed. Eyes distinct and widely separated.

In this genus the characters are intermediate between *Idya* and *Scutellidium*, the antenna, foot-jaws, and mandibles agreeing with the former, while the feet are like those of the latter genus. The only species is

Machairopus idyoides, n. sp. (Pl. XLI. figs. 1–12).

Length, 1-20th of an inch (1·3 mm.). Cephalothorax much broader than and separated sharply from the abdomen. Anterior antennæ rather densely setiferous, geniculated in the *male*. The secondary branch of the posterior antenna (fig. 4) is stout, and three- (or four- ?) jointed; the mandible (fig. 5) is tapered towards the apex, and not very strongly toothed; the basal joint of the palp is long and slender, and the branches are composed each of a single joint with five long setæ; the foot-jaws (figs. 6, 7) are both three-jointed, but the second has a longer terminal claw, is more slender, and is flexed upon itself between the first and second joints. The feet of the first pair are exactly as in *Scutellidium*, the broad lamina and knife-like apical armature of the inner branch being very characteristic (fig. 8); the outer branch is much shorter, and bears several very stout plumose setæ; the last joint is very short and broad, and has five such setæ; the first and second joints have each one or two; the outer margins of both branches are likewise densely fringed with short, rather rigid hairs. The other swimming feet (fig. 9) have equal, three-jointed branches, with densely pectinated outer margins; marginal spines slender and lancet-shaped; terminal spines long and slender. The basal joint of the fifth foot in the *female* (fig. 10) is broad and bilobed at the apex, the outer margin bearing a fringe of long, fine, and closely-set hairs, the inner margin less profusely fringed in a similar way; the apex of the outer lobe has three long, slender setæ, the inner lobe one long hair and a series of about eight small tooth-like setæ; the second joint is long and subovate, has ciliated margins, and five long, unequal apical setæ. The outer

[1] μάχαιρα, a knife; πούς, a foot.

angles of the abdominal segments (fig. 11) are pectinated with small spines, and the caudal setæ are finely aculeated along their whole length; the last abdominal segment in the *female* is very short—almost obsolete—and the distal margins of the last two segments are fringed with delicate spines. The caudal laminæ are about as broad as long, the principal setæ considerably longer than the abdomen, and finely aculeated throughout.

Two or three specimens only found in a gathering from Betsy Cove, Kerguelen Island.

Pontostratiotes,[1] n. gen.

Anterior antennæ (Pl. XLIV. fig. 4) ten-jointed; posterior (fig. 5) two-branched, the inner branch four-jointed, springing from the apex of the first joint of the main branch. Mandible very strongly toothed (fig. 6), and bearing a large two-branched palp. Maxilla (fig. 7) stout, bearing numerous stout marginal setæ; first foot-jaw (fig. 8) short and stout, divided into several marginal setiferous processes; second foot-jaw (fig. 9) slender, two-jointed (?), bearing numerous setæ on the apex and inner margin, without a terminal claw. Swimming feet of the first four pairs two-branched, all branches three-jointed (fig. 10); fifth pair (fig. 11) one-branched, three-jointed, not foliaceous. Carapace armed with several excessively long and strongly-toothed spines, which are directed backward; anterior antennæ likewise provided with numerous, variously-shaped, spine-like processes.

Pontostratiotes abyssicola, n. sp. (Pl. XLIV. figs. 1–11).

Length, 1-15th of an inch (1·6 mm). The head is extended on the ventral aspect into a strong triangular process, and laterally, just below the base of each anterior antenna, has a stout, slightly curved spine projecting almost at a right angle from the body; the posterior part of the head and anterior part of the thorax have three pairs of very long, strong, and sharply-pointed spines, which are marginally pectinated with numerous sharp tooth-like prickles. The first pair of these spines (fig. 3, *a*, *a*) arises from near the posterior border of the head, at some distance from the middle line of the body, and projects backwards to about the second or third abdominal ring; the second pair (*b*, *b*) arises on a level with the first pair, but from the lateral aspect of the body, and projects backwards to a point slightly behind the apices of the first pair; the third pair (*c*, *c*) springs from the sides of the first thoracic somite, and being of equal length with the anterior spines, extends proportionately further backwards; the posterior borders of the thoracic and abdominal segments are strongly and irregularly toothed, especially on the dorsal aspect. Anterior antennæ about two-thirds the length of the cephalothorax, ten-jointed, the first two joints nearly

[1] πόντος, sea; στρατιώτης, a soldier.

equal, and together longer than the remaining eight joints, the proportionate lengths of the joints being as follows,—17, 12, 4, 4½, 1, 1, 2½, 3½, 1½, 3½; the first joint has two multifid, spined tubercles on its anterior surface, and the posterior surface is armed with a series of short, closely set, blunt teeth; the anterior margin of the second joint has four forward-pointing sub-triangular teeth, and at the apex a much larger dagger-like spine; the other joints are scarcely at all spinous, but bear several long hairs and an olfactory filament. Posterior antennæ about half as long as the anterior pair, primary branch composed of four slender, elongated, and nearly equal joints; secondary branch attached to the apex of the first joint of the primary branch, and composed of four joints, of which the two median ones are very small. The teeth of the mandible are very deeply cleft, strong and sharp; the joints of the palp long, slender, and bearing long setæ. The first four pairs of feet have both branches three-jointed and of equal length, and the marginal spines of the outer branch are duplicated, having a very long ciliated, awl-shaped spine attached below each shorter spine. The fifth foot is one-branched only, composed of three nearly equal joints, the second joint bearing a large marginally aculeated apical spine, the third joint five of similar type, but smaller. The caudal setæ are considerably longer than the body of the animal.

This wonderful species was found—but unfortunately one specimen only, and that in a dried state—amongst material taken in the tow-net at trawl, at a depth of 2200 fathoms, lat. 37° 29′ S., long. 27° 31′ W. This single specimen was apparently much shrunk and distorted, owing to its having been dried amongst the mud in which it was taken, and on this account many of the details of structure have been very imperfectly made out; the tail-setæ, for instance, and the minor details of the mouth-organs were partly indistinguishable, the limbs much matted together, and the natural contours doubtless in other parts much altered.

Considering that this is by far the most remarkable Copepod met with amongst the Challenger captures, one must regret that some means were not found of more completely preserving Microzoa, not only from abyssal depths, but from the sea-bed of much shallower water. I have long been aware that it is by such means that the most interesting additions to the micro-fauna of the British seas, at any rate, are to be secured; and I cannot doubt that like processes would give like results in other regions. The method which I have myself successfully adopted is, after sifting out the coarse parts of a dredging, to plunge the fine residue into a quantity of sea water,—then, after allowing a few moments for most of the inorganic matter to settle, to strain off the supernatant water, which, of course, contains most of the swimming Microzoa. These, after being thus secured on a muslin filter, may be allowed to clean themselves by immersion for a short period in a vessel of salt water, and will then be obtained in a condition suitable for examination.

Goniopsyllus,[1] n. gen.

Head and first thoracic segment coalescent. Abdomen not much narrower than the cephalothorax, joints of the cephalothorax very much constricted in front, dilated behind, so as to form prominent lateral triangular processes (Pl. XLII. fig. 10). Anterior antenna six-jointed (fig. 11), posterior (fig. 12) three-jointed, destitute of a secondary branch. Mandibles wanting (?), maxillæ (fig. 13, *a*) rudimentary; anterior foot-jaw very small, feebly clawed at the apex (fig. 13, *b*); posterior (fig. 14) much larger, three-jointed, terminal claw very slender. First four pairs of feet nearly alike (fig. 15); two-branched, branches three-jointed; fifth pair (fig. 16) small, consisting of one branch only.

Goniopsyllus rostratus, n. sp. (Pl. XLII. figs. 9–16).

Length, 1-40th of an inch (0·65 mm.). Seen laterally the body is curved, moderately constricted at the internodes, and tapers evenly but very slightly from the head to the tail; the rostrum broad, prominent, and triangular; seen dorsally each cephalothoracic segment is narrowed in front, and has its posterior lateral angles produced, strongly directed outwards and backwards, and terminating in a sharp point. Anterior antennæ six-jointed (?), slender, about as long as the first body segment, sparingly setose; the last joint longer than the three preceding. Posterior antennæ three-jointed, bearing a single long seta in place of a secondary branch. Maxilla rudimentary, consisting of a very small limb, which terminates in a single claw; anterior foot-jaw small, terminating in three small claw-like setæ; posterior foot-jaw three-jointed, first two joints long, slender, and nearly equal, third rudimentary, apical claw curved and extremely slender. The first four pairs of feet have the inner branches a little longer than the outer; both branches bearing long setæ but no spines; the fifth pair short, simple, three-jointed, bearing one short and two long terminal setæ. Caudal segments very short; terminal setæ two or three, very short.

One specimen only—a male—of this curious species was found. It occurred in a tow-net gathering from Station 318, lat. 42° 32′ S., long. 56° 27′ W.

Its nearest allies are probably to be found in the genera *Enhydrosoma*, Boeck, and *Cletodes*, Brady (=*Lilljeborgia*, Claus), but the mouth-organs in these genera are totally different in character. In *Goniopsyllus* the maxillæ and foot-jaws are extremely small, and the mandible appears to be altogether absent; at any rate I was unable to find it. The peculiar bend of the feet upon their basal joint calls to mind a similar conformation in *Peltidium*, while the absence of a secondary branch in the posterior antenna, and the rudimentary character of the mouth-organs, show an affinity to the Saphirinidæ.

[1] γώνια, an angle; ψύλλος, a flea.

Setella, Dana.

Setella, Dana, Crust. U. S. Expl. Exped. (1852)

Body extremely slender, almost linear, and bearing beneath the front of the head a short and broad but sharply-pointed beak-like appendage. Head and first thoracic segment coalescent. Anterior antennæ slender, bearing on the fourth joint an (olfactory?) appendage; posterior antennæ unbranched. Mouth-organs excessively minute. Mandible-palp rudimentary. Maxillæ and first pair of foot-jaws short and uncinate; second pair of foot-jaws larger, and forming a clawed hand. Fifth pair of feet foliaceous. Caudal setæ very long.

Setella gracilis, Dana (Pl. L. figs. 1–10).

Setella gracilis, Dana, Crust. U. S. Expl. Exped. (1852), p. 1198, pl. lxxxiv. fig. 3, *a–g*.

Length, 1-18th of an inch (1·4 mm.). The head is tapered towards the front, and bears a stout, lancet-shaped rostrum. Abdomen in the *female* four- in the *male* five-jointed; margin of the penultimate segment finely pectinated; caudal segments slender, as long as the three preceding abdominal segments; principal setæ two, the innermost very long, more than equalling the length of the whole body of the animal, the outer seta about as long as the caudal stylet; both are finely aculeated through their entire length. Anterior antenna slender and very sparingly setiferous, that of the *female* eight-jointed, about as long as the cephalothorax; that of the *male* (fig. 2) geniculated, slightly swollen above the middle, and terminating in a slender slightly falciform joint; posterior antenna (fig. 3) three-jointed, simple, bearing at the apex three small subequal setæ, and two much smaller marginal hairs. Mandible (fig. 4) very small and feebly toothed at the apex; palp consisting of one small seta; maxilla (fig. 5) simple, subhamulate, without a palp; anterior foot-jaw (fig. 6) provided with a stout curved apical seta, and with two or three marginal unisetiferous processes; posterior (fig. 7) elongated, much larger than the preceding, two-jointed, bearing at the apex a short curved claw, and on the middle of the inner margin of the second joint a brush-like tuft of small fine hairs. First four pairs of feet long and slender (fig. 8), two-branched, the branches nearly equal, three-jointed; fifth pair rudimentary, each branch consisting in the *female* (fig. 10) of a single joint, the apices of both and the outer margin of the outer branch being setiferous; in the *male* (fig. 9) the inner branch is represented only by a couple of small setæ.

Of this interesting genus Dana has described five species, some of them, perhaps, of doubtful validity; Claus one species, *Setella messinensis*, from the Mediterranean, and Boeck one, *Setella norvegica*. The Challenger specimens agree most closely with Dana's *Setella gracilis*, but the differences between this species and *Setella tenuicornis* appear to be of the very slightest character.

Habitat.—The following gatherings contained specimens of *Setella gracilis*:—Surface-net collections taken in January and February 1875, off the north coast of Papua, and among thePhilippine Islands; between Api and Cape York, north of the Sandwich Islands, in lat. 30° 22′ N., long. 154° 56′ W. (abundant); in lat. 36° 44′ S., long. 46° 16′ W. (Station 325); lat. 9° 43′ S., long. 13° 51′ W. (Station 342); lat. 3° 10′ N., long. 14° 51 W. (Station 348); at Zamboanga (abundant); and in lat. 13° 50′ S., long 151° 49′ E. (Station 181); in lat. 9° 9′ N., long. 16° 41′ W. (Station 351).

Section II. Pœcilostoma, Thorell.

Family I. Corycæidæ, Dana.

Cephalothorax elongated or subpyriform, abdomen much narrower, usually elongated, and distinctly separated from the cephalothorax. Anterior antennæ alike in both sexes (? except in *Lubbockia*), five or six-jointed; posterior simple, three- or four-jointed, forming a prehensile hand, which is clawed or armed with curved prehensile setæ at the apex. Mouth-organs (except the posterior foot-jaws) minute, and destitute, or nearly so, of palps. Posterior foot-jaw prehensile, and in the male powerfully clawed. First four pairs of feet alike, or nearly so, adapted for swimming, two-branched, and armed with lancet-shaped lateral spines; fifth pair rudimentary, alike in both sexes; rarely absent. Heart wanting. In addition to two small median eyes, there are usually two lateral eyes, with large, conspicuous lenses (eyes absent in *Lubbockia*?); ovisacs usually two.

In the Monograph of the British Copepoda, I followed Thorell in separating the Saphirinidæ and Corycæidæ, but have here adopted the older, simpler, and, as I now think, the more natural plan adopted by Dana and Claus. The Saphirinidæ occupy, in fact, a very similar position in relation to the Corycæidæ, as the Peltididæ to the Harpacticidæ, the differences being more of outward appearance than of structure.

Coryċæus, Dana.

Corycæus Dana, Proc. Acad. Nat. Sci., Philadelphia, 1845.

Body elongated, subcylindrical (Pl. LII. figs. 1, 2); abdomen two-jointed, penultimate segment of the cephalothorax produced ventrally into two hook-like processes, last joint of the cephalothorax very small and overlapped by the preceding joint. Anterior antennæ (fig. 6) six-jointed, short; posterior (figs. 7, 8) uncinate, strongly prehensile, terminal claw longer in the male. Mandibles (fig. 9, *a*) divided into two apical processes (*a′*, *a′*), and bearing a small setiferous palp (*a″*); maxilla (fig. 9, *b*) composed of an uncinate lamina and several setiferous marginal processes. Anterior

foot-jaws (fig. 10) small, alike in both sexes, produced apically into a strong hook-like extremity, and bearing on the inner margin several ciliated setæ; posterior foot-jaws (fig. 11) elongated, three-jointed, forming a strongly clawed prehensile hand, the claw larger in the male. First, second, and third pairs of feet with both branches three-jointed (figs. 12, 13), inner branch of the fourth pair (fig. 14) quite rudimentary, or replaced by a single small hair. Fifth pair of feet wanting or excessively minute. Frontal eyes two, each composed of a single, large, colourless, highly refracting lens, situated near the base of the anterior antennæ; median eyes very small.

The principal distinctive characters of this genus are the very large frontally situated corneal lenses, the broad, cylindrical cephalothorax, the very narrow abdomen, consisting only of two-joints and distinctly separated from the cephalothorax, the large, prehensile, posterior antennæ, the one-branched fourth foot, and the absence or very rudimentary characters of the fifth pair. From the most closely allied genus (*Saphirina*), the cylindrical, non-complanate character of the cephalothorax and styliform build of the abdomen distinguish it at a glance.

But though the genus is at once and easily recognisable, the indication of specific characters is a most perplexing task. From the large number of gatherings which have come under my notice it would be easy enough to pick out a considerable number,—perhaps half a dozen types,—which, were we to ignore intermediate forms, might serve for the foundation of as many separate species. But there would still remain numerous individuals, not precisely agreeing at all points with the types, but, allowing for slight variations, referable indifferently to several species. The characters upon which, chiefly, the species already described have been founded are,—the general outline of the body, position of the eyes, form of the two pairs of antennæ and posterior foot-jaws, and of the caudal stylets. I have not, however, been able to satisfy myself of the validity of many of the so-called specific distinctions which have been based upon these variations, so that, while not venturing to deny the possible existence amongst the Challenger collections of more species than I have admitted, it seems to me more consistent with the present state of our knowledge to allow a very wide margin for variation, and so to restrict very considerably the number of specific types. I feel sure, for instance, that some of Dana's species are founded upon characters belonging to immature or quite young forms,—the form and proportions of the caudal stylets and the armature of the posterior antennæ, being notably, as I believe, variable with the growth of the individual. But without the opportunity of observing accurately the growth and development of the animals, it is of course impossible to speak with absolute confidence on these points. We must always bear in mind the possibility of two or more species being mixed up in the same gathering, and when these are very closely allied, and in various stages of development, it becomes almost impossible to unravel the knot.

1. *Corycæus varius*, Dana (Pl. LII. figs. 1–14).

Corycæus varius, Dana, Crust. U.S. Expl. Exped. (1852), p. 1211, pl. lxxxv. fig. 4, *a–i*.
„ *longistylis*, Dana, Ibid. p. 1212, pl. lxxxv. fig. 5 *a–d*.
„ *styliferus*, Lubbock, On Entomostraca collected by Dr. Sutherland, Trans. Entom. Soc., vol. iv., N. S., pl. v. figs. 7, 8 (1856).
„ *furcifer*, Claus, Die frei lebenden Copepoden (1863), p. 157, pl. xxiv. figs 7–12.

Length, 1-8th of an inch (3 mm.). Body slender and elongated; third thoracic segment produced into two long and acutely-pointed lateral processes, which extend as far backwards as the middle of the abdomen (figs. 1, *a*, *a*, and fig. 3, *a*); caudal stylets variable in length, but in the adult many times longer than broad, and usually about twice as long as the abdomen. Anterior antennæ (fig. 6) less than half as long as the first segment of the body, six-jointed, the joints of nearly equal length; posterior antennæ (fig. 7 *male*, fig. 8 *female*) much larger, and forming a strongly prehensile limb, basal joint bearing two very long spine-like setæ, second joint subquadrate, produced at its inner distal angle into a broad acutely pointed, triangular tooth, third joint small, bearing a few small curved, acuminate setæ, and at the apex an extremely long falcate claw, which when flexed on the limb interlocks with the two long setæ of the basal joint. In the *female* the terminal claws are much shorter than in the *male*, while the triangular tooth of the second joint is larger. Posterior foot-jaw (fig. 11) prehensile, and armed with a long, falciform apical claw, at the base of which are two small flagellate setæ (fig. 11, *a*). Inner branches of the first three pairs of swimming feet (figs. 12, 13) very short. Distal extremities of the caudal stylets slightly dilated (fig. 1, *a*), and giving attachment to several setæ, the innermost being robust and about half the length of the stylet, the second half the length of the first, the third rather longer than the second, but much more slender and flexuose; there is also a small spine at the outer angle, and a very minute marginal seta a little removed from the apex of the stylet. The eyes are situated quite on the front of the head, quite distinct and remote one from the other towards the side of the body.

Habitat.—Forms which I refer to *Corycæus varius* occurred in the surface gatherings from a very large proportion of the places visited by the Challenger. The following list of localities shows the wide distribution of the species:—Off Port Jackson, Australia; between Sydney and Wellington; off Kandavu, Fiji; between Api and Cape York; off south of Papua; at many localities amongst the Philippine Islands; Pacific, north of the Sandwich Islands, in lat. 30° 22′ N., long. 154° 56′ W. (Station 256); in lat. 36° 32′ S., long. 132° 52′ W. (Station 287); lat. 37° 3′ S., long. 44° 17′ W. (Station 326); lat. 32° 24′ S., long. 13° 5′ W. (Station 335); lat 12° 16′ S., long. 13° 44′ W. (Station 341); lat. 9° 43′ S., long. 13° 51′ W. (Station 342); lat. 3° 10′ N., long. 14° 51′ W. (Station 348); in various localities between lat. 5° 28′ N., long. 14° 38′ W.; and lat. 10° 55′ N., long. 17°

46′ W. (Stations 349–352); in lat. 26° 21′ N., long. 33° 37′ W. (Station 353); in lat. 13° 50′ S., long. 151° 49′ E. (Station 181).

The list of synonyms which I have assigned to this species might, I feel sure, be very considerably enlarged, some of the forms described by various authors being, as I think, founded upon stages of development of *Corycæus varius*.

2. *Corycæus pellucidus*,[1] Dana, (Pl. LII. figs. 15–19).

Corycæus pellucidus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1224, pl. lxxxvi. fig. 6.
„ *rostratus*, Claus, Die frei lebenden Copepoden (1863), p. 157, pl. xxviii. fig. 5.

Length, 1-26th of an inch (·97 mm.). Body moderately elongated; abdomen short and composed of one joint only (fig. 15); first body-segment produced between the foot-jaws and the first pair of swimming feet into a broad conical prominence; third thoracic segment produced into broadly triangular lateral processes reaching to the middle of the abdomen, and completely hiding the fourth segment. Anterior antennæ (fig. 16) six-jointed; posterior not very powerfully prehensile (fig. 17), basal joint long and bearing two long, plumose, spine-like setæ, second joint narrow, and possessing no marginal teeth; terminal claw short and weak. Posterior foot-jaw (fig. 18) small, and bearing on the inner margin of the hand a small plumose hair. Caudal stylets (fig. 19) much shorter than the abdomen, about four or five times as long as broad, the terminal setæ short. All the specimens seen were females, and many of them had attached to the abdomen bundles of spermatic tubes, very large for the size of the animal, and tapering to each extremity. These are shown in fig. 19.

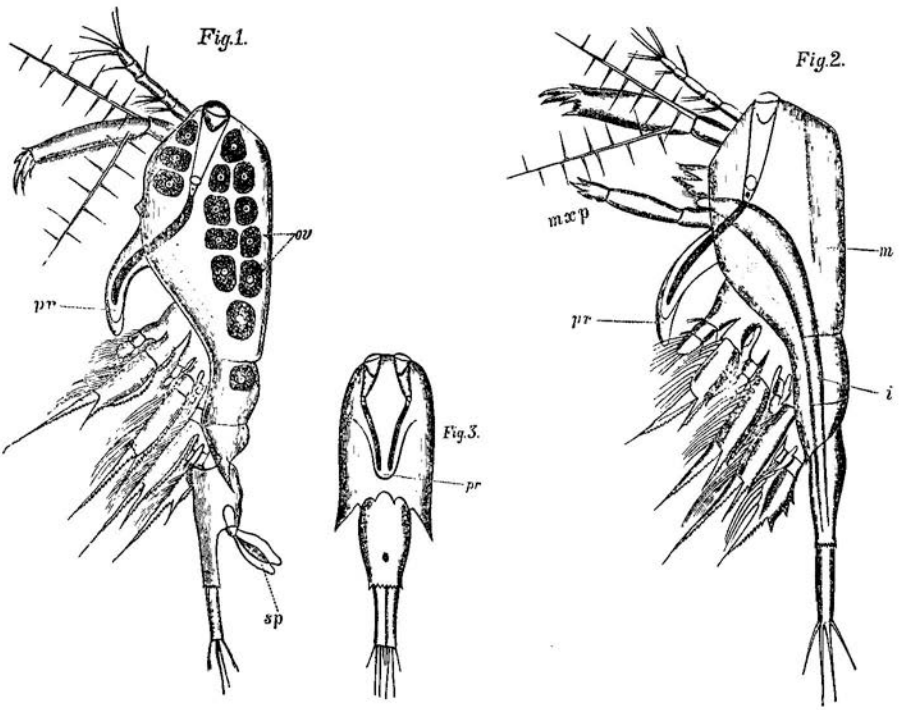
A few specimens only of this species occurred in the following gatherings:—South Pacific, December 5, 1875; in lat. 36° 44′ S., long. 46° 16′ W. (Station 325); in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); and at St. Vincent, Cape Verde Islands.

The following interesting remarks of Dr. v. Willemoes Suhm refer to a species which appears to be identical with *Corycæus pellucidus*, the only important differences between our specimens and v. Willemoes Suhm's figures being found in the pectoral process—which in "*megalops*" is much curved and rather slender, in *pellucidus* straight and obtusely conical—and the eyes, which in *pellucidus*, are considerably larger; this latter point, however, need not be much insisted on, as v. Willemoes Suhm especially remarks upon the "extraordinary size" of the eyes. The figures, which are valuable as having been taken from the living animal, are reproduced in the woodcut. Dr. v. Willemoes Suhm's note is as follows:—

Corycæus megalops.—On our way from Teneriffe to St. Thomas, in lat. 23° 10′ N., and long. 38° 42′ W., I found, among the animals which were got by the towing-net on the surface, a little blue Copepod, which especially attracted my attention by the large size of its eyes. The peculiar long

[1] In the table of species (p. 5) this is given as *Corycæus rostratus*.

pigmented body and the two lenses united by a tube showed at once that this was a member of the family Corycæidæ, and a glance at Leuckart's picture of *Corycæus germanus* proved that this genus, with its rudimentary development of the fifth thoracic ring, was the one to which it belonged. For I do not think that the extraordinary pectoral process into which the pigmented bodies of the eyes extend makes it necessary to establish for this form a new genus. In the following description I shall especially dwell upon those points in which our animal, which I propose to call *Corycæus megalops*, differs from *Corycæus germanus*, Leuck.



Corycæus pellucidus, Dana (from Dr von Willemoes Suhm's figures).

FIG. 1.—Female, seen from left side. FIG. 2.—Male, seen from left side. FIG. 3.—Female, seen from dorsal surface. *Pr.*, ocular process; *ov.*, ova; *sp.*, spermatophores; *mxp.*, posterior foot-jaw; *i.*, intestine; *m.*, dorsal muscles.

The female has a length of 0·87 mm. and a width of 0·35 mm., its somewhat larger size and the blue colour of its ovary distinguish it easily from the male. In both sexes the eyes (which are composed of two lenses, a tube, and a red pigmented body) have an extraordinary size, as the pigmented bodies extend into a pectoral process, which is as long as the first pair of legs and somewhat bent backwards (figs. 1, 2, 3, *pr.*).

The first antennæ are amply supplied with olfactory hairs in both sexes. The second ones, somewhat larger in the male, are terminated by curved spines, which are especially numerous in the

male; they have besides in both sexes two large spiniferous setæ, originating from the base of the last joint. In the mandibles and maxillæ I have not seen anything remarkable; the maxillipedes however, are very large (fig. 2, *mxp.*), and terminated by three claws. In *Corycæus germanus* there is only one recurved nail. The four pairs of thoracal feet are no doubt powerful natatory organs, as they are, especially in the male, very broad and covered with long hairs. The fifth pair, a rudiment of which is to be found in *Corycæus germanus*, could not be observed here.

The thorax ends in the female with a very sharp and slender spine, which is not so strongly developed in the male. The abdomen is reduced in *Corycæus* to two joints, which in our case are even not clearly to be distinguished, though I think that in the female the first abdominal segment ends behind the genital opening (fig. 1, *sp.*), but in the male is inseparably connected with the last one. The furca is terminated by two large and two small spines. As can be seen from our pictures, the shape of the abdominal segment is very different in both sexes; in the female it is swollen up nearly square, and has some small spines on the angle, which is formed at its inferior frontal side. In the specimen I have drawn, some oval spermatozoa were attached to the vulva (fig. 1, *sp.*). In the male this abdominal segment is very different; it is more in continuance with the thoracal part of the body, and has no prominent angle at its underside. I could not find the genital opening in the male, which in the female is at the upper surface of the segment.

From the species hitherto known, *Corycæus megalops* differs especially by the pectoral process, by the want of the last and fifth pairs of thoracal feet, and by the union of the two abdominal segments. It will always be a curious fact that in this species the outlines of the cephalothorax have given way so far as to form a long process to receive the immensely increased eyes. Length of female, 0·875 mm., width 0·350 mm.

The species was in considerable quantity in the surface-water for two days, but since that time has never been seen again.

3. *Corycæus limbatus*, n. sp. (Pl. XLIX. figs. 18–22).

Length, 1-16th of an inch (1·55 mm.). Body slender; posterior thoracic spines moderately long, reaching to about the middle of the first abdominal segment, which is about three times as long as the second; caudal stylets slender, about eight times as long as broad, not divergent. Anterior antennæ short; posterior slender, the terminal claw in the *male* (fig. 19) long, slender, and falcate; inner margin of the second joint bordered with a pellucid and very finely pectinated lamina, which is best developed on the distal half; posterior foot-jaw (fig. 20) rather small, with a flexuous terminal claw. The marginal spines of the swimming feet (fig. 21) are lancet-shaped, with delicately pectinated margins, and the usually vacant interspinous spaces are occupied by supplementary spines (*a*, *a*), which, however, are not free, but anchylosed by the inner edge with the limb. Eyes contiguous, situated immediately on the front of the head.

This species was noticed only in one gathering from the tropical Atlantic, in lat. 12° 16′ S., long 13° 44′ W. Only one or two specimens were seen, but the characters are amply sufficient to distinguish them from any described form.

4. *Corycæus venustus*, Dana (Pl. LIV. figs. 8-10).

Corycæus venustus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1222, pl. lxxxvi. fig. 4, *a–d*.
„ *huxleyi*, Lubbock, On some Oceanic Entomostraca, &c., Trans. Linn. Soc., vol. xxiii. p. 182, pl. xxix. figs. 8, 9.

Length, 1-12th of an inch (2·1 mm.). Cephalothorax broad and scarcely narrower behind than in front; lateral processes of the third segment long, acute, and somewhat spreading; abdomen constricted at the base, and only half as long as the cephalothorax; caudal segments (fig. 10) generally more or less divergent, and equal to about half or three-quarters of the length of the abdomen; terminal setæ three, the innermost flexuous, slender, considerably longer than the furca, the second about half as long, stouter, and rigid; outermost still shorter and hair-like; a small marginal seta slightly removed from the apex. Terminal claws of the posterior antennæ (fig. 9) reaching not much beyond the middle of the hand, strongly hooked at the apex, and having a small hooked marginal spine at their attachment to the last joint of the limb.

The generally smaller size of the animal, the shorter and stouter caudal segments, the comparatively small and very strongly falcate claws of the posterior antennæ, are the characters which chiefly distinguish this species from *Corycæus varius*. The following list of localities includes all of which I have record, but the species certainly occurred in some others, of which I have no note, owing to my failure at first to recognise it as a distinct specific type.

Habitat.—Between Sydney and Wellington; between Api and Cape York; in five gatherings from the Philippine Islands; in lat. 3° 10′ N., long. 14° 51′ W. (Station 348); and in lat. 26° 21′ N., long. 33° 37′ W. (Station 353).

5. *Corycæus speciosus*, Dana (Pl. XLVI. figs. 5, 6).

Corycæus speciosus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1220, pl. lxxxvi. fig. 1, *a–d*.

Length, 1-10th of an inch (2·55 mm.). Animal elongated and slender, forehead narrow and rounded; thorax slightly constricted in front and wider behind, spines directed straight backward, and reaching as far as the hinder edge of the first abdominal segment; caudal stylets divergent, as long as the abdomen, and excessively slender. Anterior antennæ clothed with numerous setæ, most of which are at least twice as long as the limb itself. Eyes large, remote, situated near the sides of the head.

Corycæus speciosus was found in the tropical Atlantic, in lat. 1° 47′ N., long. 24° 26′ W. (Station 106). Dana's specimens (two only) were taken not far from the same place, and though the description gives the anterior antennæ as seven-jointed, I do not doubt that the same species is meant.

6. *Corycæus obtusus*, Dana (Pl. XLVI. figs. 7–9).

Corycæus obtusus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1214, pl. lxxxv. fig. 6.
? „ *anglicus*, Lubbock, Ann. and Mag. Nat. Hist., vol. xx. (1857), pl. xi. figs. 14–17; Brady, Monog. Brit. Copep., vol. iii. p. 34 pl. lxxxi. figs. 16–19, pl. lxxxiii. figs. 11–15, pl. lxxxiv. figs. 10–14.

Length, 1-29th of an inch (·87 mm.). Animal rather robust, broadly rounded in front; posterior thoracic spines rather short and stout, about one-third the length of the first abdominal segment, which is at least twice as long as the second, and bears at the antero-ventral angle a small projecting spine; caudal stylets as long as the preceding segment, and not divergent; setæ about half as long as the abdomen. Anterior antennæ clothed with setæ, none of which are much more than half the length of the limb. Lenses large, situated near the sides of the head. The colour of the animal is a beautiful sea-green, the ocular stylets a much deeper shade of the same.

A few specimens of this extremely pretty little species were taken in the Inland Sea of Japan. Having been mounted on the spot, the colour of some of them was beautifully preserved. It is the only species, excepting *Corycæus anglicus*, in which I have seen the peculiar little spine of the first abdominal segment, and this character, together with the small size, seems to identify it unmistakably with *Corycæus obtusus*, Dana, the types of which, however, were found in the Pacific Ocean near El Gran Cocal, 5½ degrees south of the equator. A single specimen was noticed also in a mounting of specimens from lat. 36° 44′ S., long. 46° 16′ W. (Station 325). I am unable to detect any material difference between this species and *Corycæus anglicus*, Lubbock.

Copilia, Dana.

Copilia, Dana, Proc. Amer. Acad. Sci., 1849.

Body somewhat depressed, broadly quadrate in front, and bearing at each angle a prominent simple corneal lens (anterior eye); abdomen much attenuated, five-jointed. Anterior antennæ (Pl. LIII. fig. 3) short, six-jointed (?); posterior very large, strongly prehensile, and terminating in a long, curved claw. Mandibles (fig. 6) short, truncated, destitute of a palp, the broad distal extremity finely denticulated and produced at the inner aspect into a slender falciform process; maxillæ (? fig. 7) slender, deeply divided at the apex into three digitiform segments; anterior and posterior foot-jaws (figs. 8, 9) very small, simple, and terminating in slender prehensile claws. Four pairs of swimming feet, having both branches three-jointed, except the fourth, where the inner branch consists of only one joint. Fifth pair one-jointed, rudimentary. Pigment bodies of the posterior eyes distant, and bent into an angular form.

Copilia mirabilis, Dana (Pl. LIII. figs. 1–11).

Copilia mirabilis, Dana, Crust. U. S. Expl. Exped. (1852), p. 1232, pl. lxxx. fig. 14, *a–g*.
,, *denticulata* (?), Claus, Die frei lebenden Copepoden, p. 161, pl. xxv. figs. 14–20.

Length, 15-100ths of an inch (3·6 mm.). The first cephalothoracic segment is quadrangular, much broader than, and as long as, the rest of the body, exclusive of the caudal stylets; the last two thoracic segments are much smaller than the rest and are prolonged on the dorsal aspect into a triangular median spine, and the posterior borders of the abdominal segments are denticulated; the last abdominal segment is as long as the preceding five, and somewhat dilated at the distal extremity; the caudal stylets excessively long and slender, almost linear, divergent, about half as long as the body of the animal, and bearing a few very short terminal setæ. Anterior antennæ (fig. 3) six-jointed, small, rather sparingly setiferous, and reaching only about half-way to the posterior margin of the first body-segment. Posterior antennæ (figs. 4, 5) very large, reaching to the hinder extremity of the first segment, four-jointed, and terminating in a strong, curved claw, second and third joints each bearing a strong marginal spine; in some examples (? *males*) this spine is branched in a radiate manner near the base (fig. 5). The swimming feet (fig. 10) are short, the external and internal branches of the first four pairs being three-jointed and equal in length; marginal spines of the external branches obsolete; inner branch of the fourth pair (fig. 11) consisting of one joint only; fifth pair of feet wanting (?), or rudimentary.

Habitat.—This species occurred very sparingly in several gatherings; except in one instance not more than two or three examples were noticed in the material which passed through my hands from any one locality. The following list includes all the gatherings in which the species occurred:—Off Sibago Island, and in several other gatherings from amongst the Philippine Islands; off the north coast of Papua; off Kandavu, Fiji; between Api and Cape York; near the Ki Islands (Station 181); Zamboanga; in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); in lat. 5° 28′ N., long. 14° 38′ W. (Station 349); and in lat. 10° 55′ N., long. 17° 46′ W. (Station 352). It will be seen from this list that all the localities in which *Copilia* was captured may be assigned to two widely distant areas, the most important area including Polynesia and the Malay Archipelago; the other the North Atlantic, off the west of Africa. I have not been able to detect any important differences amongst the specimens taken from the various places, but the action of the preservative spirit has in all cases so destroyed or obscured the more delicate internal structures, that I have been obliged to rely upon the observations of previous writers for descriptions of those parts. In other respects, many of the specimens were in good condition, except as to the setæ of the caudal stylets, none of which appear to be perfect. The mouth-organs are extremely minute, and—in spirit-specimens at any rate—difficult of observation, and I am by no means sure that my drawings of those parts

may not require emendation. In general character, however, it is clear that these organs are very similar to those of such genera as *Corycæus* and *Lichomolgus*. As to specific characters, I find nothing to separate the Challenger captures from the form described by Dana as *Copilia mirabilis*, and it is perhaps doubtful whether either Dana's second species *Copilia quadrata*, or the *Copilia denticulata* of Claus, is sufficiently distinct to entitle it to stand as separate species. I have not been able to distinguish certainly the two sexes of this species, though the slight differences observable in the structure of the posterior foot-jaws may possibly be of sexual importance.

Lubbockia, Claus.

Lubbockia, Claus, Die frei lebenden Copepoden (1863).

Body narrow and elongated; eyes wanting. Anterior antennæ six-jointed; posterior four-jointed, and armed at the apex with several curved prehensile setæ. Mouth-organs small, very like those of *Corycæus;* posterior foot-jaws very large, prehensile. First four pairs of feet having both branches three-jointed,—the internal much the longer; fifth pair rudimentary. Abdomen four-jointed in the female, five-jointed in the male. Ovisac single.

Lubbockia squillimana, Claus (Pl. LIII. figs. 12–16, and Pl. LIV. figs. 1–7).

Length of *female*, 1-15th of an inch (1·6 mm.), of *male* 1-12th of an inch (2·1 mm.). The cephalothorax and abdomen are about equal in length, the latter excessively slender, and separated very distinctly from the thorax; thorax very narrowly ovate, the last segment, in the *female*, having produced lateral angles, and sharply separated from the rest, lateral angles of the last but one produced on the posterior aspect, so as to form two short spines. Anterior antennæ of the *female* (Pl. LIII. fig. 12) six-jointed, scarcely one-third as long as the first body segment; posterior (fig. 13) slightly shorter, and clothed with numerous nearly equal hairs; in the *male* (Pl. LIV. figs. 3, 4) the anterior antenna has several small and one very long seta, nearly as long as the entire animal. The posterior foot-jaw of the *female* (Pl. LIII. fig. 14) is very large, and forms a strongly clawed prehensile organ, the hand armed on its concave edge with four or five very stout triangular spines, the terminal claw longer than the hand, stout and falcate; that of the *male* (Pl. LIV. fig. 7) is much smaller, and the hand is destitute of spines. The swimming feet (Pl. LIII. fig. 15) have the marginal spines of the outer branch laminar and leaf-like, or lancet-shaped, with very finely serrated edges,—very delicate in structure and pellucid, The fifth foot (fig. 16) consists of a single joint, terminating in two laminated setæ or spines like those of the swimming feet. The abdomen is in the *female* equal to about two-thirds, and in the *male* to the entire length of the cephalothorax; it is extremely

slender, the joints being from twice to thrice or four times as long as broad, the caudal stylets very slender, and bearing four terminal setæ, the longest of which are about twice as long as the furca.

Habitat.—In lat. 6° 48′ N., long. 122° 25′ E. (Station 200); lat. 40° 3′ S., long. 132° 58′ W. (Station 288); lat. 9° 43′ S., long. 13° 51′ W. (Station 342); lat. 12° 16′ S., long. 13° 44′ W. (Station 341); lat. 5° 28′ N., long. 14° 38′ W. (Station 349); lat. 9° 9′ N., long. 16° 41′ W. (Station 351).

All these are Atlantic Stations, and situated either within or near the tropics, but the type specimens described by Dr. Claus were taken in the Mediterranean (Messina), and, so far as appears, are in every respect similar to those brought home by the Challenger. The male was not seen by Dr. Claus, but I think there can be little doubt that the form figured here in Pl. LIV. figs. 3, 4, is referable to that sex; in all structural details it agrees with the female *Lubbockia squillimana*, except in the presence of a single very long antennal seta, in the weaker build of the posterior foot-jaw, the somewhat different form of the last two thoracic segments, and the slightly larger size of the animal. Only two examples of the male were found, both from Station 349. From the other Stations only very few specimens have been discovered, not more than about a dozen in all.

Oncæa, Philippi.

Oncæa, Philippi, Wiegmann's Archiv, 1843.
Antaria, Dana, Proc. Amer. Acad. Sci., 1849.

In general appearance much like *Corycæus*. Corneal lenses (conspicilla) small, situated in the front of the head. Fifth thoracic segment very small, and bearing a pair of very minute rudimentary feet. Abdomen of the male five-, of the female four-jointed, the median joints very small, first joint very large. Anterior antennæ short, six-jointed, posterior, three-jointed, prehensile, the last joint armed with numerous setæ. Swimming feet four pairs; all the branches three-jointed.

The generic name *Oncæa*, proposed by Philippi, is ignored by Claus on the ground of insufficient description, but Philippi's figures are so characteristic as to leave no doubt, as I think, of the animal to which they are intended to apply; the description also, as far as it goes, is perfectly applicable, though incomplete, owing to the accidental loss of the specimen before the author's observations were finished. On the ground of priority, therefore, it seems right to adhere to the name *Oncæa*.

The genus is a very interesting one, as though agreeing with other Corycæidæ (and especially with *Corycæus*) in the essential characters of mouth-apparatus, as well as in the general appearance of the animal, it differs altogether in the structure of the posterior antennæ, which, though prehensile, are more like those of *Cyclops*, and of the foot-jaws, which resemble those of some Harpacticidæ; the caudal stylets are very distinctly Cyclo-

poid in shape. These animals are very widely distributed, and often occur in great numbers, but it seems doubtful whether all those hitherto observed may not fairly be referred to one species. The forms assigned by Dana to three distinct species are very probably founded upon various stages of development of one only.

Oncæa obtusa, Dana (Pl. LI. figs. 1–11).

Antaria obtusa, Dana, Crust. U. S. Expl. Exped. (1852), p. 1230, pl. lxxxvi. figs. 13, *a–e*.
„ *mediterranea*(?), Claus, Die frei lebenden Copepoden (1863), p. 159, pl. xxx. figs. 1–7.
Oncæa venusta (?), Philippi, Wiegmann's Archiv, 1843, pl. iii. fig. 2.
„ *pyriformis*, Lubbock, On some Oceanic Entomostraca, &c., Trans. Linn. Soc., vol. xxiii. p. 183, pl. xxix. figs. 24, 25.

Length, 1-20th of an inch (1·3 mm.). Body constricted at the junction of the thorax and abdomen; conical lenses inconspicuous. Anterior antennæ (fig. 4) six-jointed, nearly equally thick throughout, not half as long as the first body-segment; third joint much the longest, and exceeding in length the last three joints; last joint of the posterior antennæ (fig. 5) small and armed with two fascicles of curved setæ; basal joint with one apical seta. Mouth-organs minute; mandibles (fig. 6, *a*) armed at the apex with several laciniated teeth; maxilla (fig. 6, *b*) with six or seven slender spine-like setæ; anterior foot-jaws (fig. 7) divided into two stout terminal spine-like processes, which are profusely pectinated on the inner margin, also one slender naked seta; posterior foot-jaw forming a strongly clawed prehensile hand, which in the *female* (fig. 8) is elongated, tapering, and bears on the inner margin two stout setæ and a series of fine short hairs; terminal claw stout, falciform; in the *male* (fig. 9) the hand is broadly ovate, destitute of long marginal setæ, but provided with a continuous series of fine hairs, terminal claw long and rather slender. The swimming feet (figs. 10, 11) have their external and internal branches of nearly equal length, the first two joints being in all cases much the shortest; marginal spines long, dagger-shaped, with finely serrated edges. Fifth pair of feet extremely small, consisting of a minute tubercle armed with one or two small apical setæ. First joint of the abdomen in both sexes very large, much longer than all the rest of the abdominal segments put together, and in the *male* having the posterior angles acutely produced; second, third, and fourth segments of the *male* extremely short; caudal stylets in both sexes about thrice as long as broad, each armed with three subequal terminal setæ, the longest of which is about half as long as the abdomen, one smaller terminal and one lateral seta. Ovisacs two, borne closely adpressed to the back of the abdomen, and reaching, when the ova are mature, nearly to its extremity.

Habitat.—From the following list of localities it will be seen that *Oncæa obtusa* may fairly be called a cosmopolitan species—excepting, perhaps, from this statement the colder waters of the extreme north and south temperate zones. The Mediterranean is the most northerly region in which it has yet been observed, and indeed had it extended into the

North Sea or the North Atlantic, it must before now have been found in some of the numerous collections made in those areas. In some of the Challenger gatherings it occurred very abundantly, notably in those from the Australian coasts, and especially in gatherings made at night-time :—Off Cape Howe, Australia (at night); off Port Jackson (night and day); between Sydney and Wellington; off Kandavu, Fiji; between Api and Cape York; between Arrou and Banda; off north and south of Papua; at several Stations amongst the Philippine Islands; in lat. 13° 50′ S., long. 151° 49′ E. (Station 181); east of Japan (Station 237); in lat. 30° 22′ N., long. 154° 56′ W. (Station 256); in the South Pacific (December 5, 1875); in lat. 42° 43′ S., long. 82° 11′ W. (Station 302); in lat. 45° 31′ S., long. 78° 9′ W. (Station 303); in lat. 36° 44′ S., long. 46° 16′ W. (Station 325); in the South Atlantic, lat. 38°, from March 3 to 5, 1876; in lat. 9° 43′ S., long. 13° 51′ W. (Station 342); in lat. 5° 28′ N., long. 14° 38′ W. to lat. 9° 9′ N., long. 16° 41′ W. (Stations 349, 350, 351), and off St. Vincent, Cape Verde (April 26, 1876).

Pachysoma, Claus.

Pachysoma punctatum, Claus.

Pachysoma punctatum, Claus, Die frei lebenden Copepoden (1863), p. 163, pl. xxv. figs. 6–11.

One specimen thus named by Dr. von Willimoes Suhm, was taken off Zamboanga. In its present condition it is incapable of accurate identification, having been mounted for the microscope and a good deal distorted; but so far as I can make out, the name is probably correct.

Saphirina, Thompson.

Saphirina, Thompson, Zoological Researches, 1829.

Body flattened, ovate or subovate, abdomen of the female usually much narrower than the cephalothorax[1]; last thoracic segment, in the male, rudimentary; fifth pair of feet small, one-jointed. Swimming feet two-branched; both branches three-jointed. Anterior antennæ five- or six-jointed, the second joint elongated; posterior pediform, four-jointed, clawed. Caudal stylets laminated. Males often opaline or iridescent. Unpaired eye, vesiculiform. Pigment-bodies of lateral eyes styliform.

The species belonging to this genus, though occasionally parasitic (as in *Salpæ*), are taken generally by the towing net near the surface of the sea, and a large number have been described from various parts of the world,—notably from the Atlantic, Pacific, and Mediterranean. In many of those points, however, which usually afford the best specific

[1] The number of abdominal segments is stated by Dana to be five or six, but the last thoracic segment is counted by this author as belonging to the abdomen.

characters,—as, for instance, the mouth-organs and feet,—these so-called species differ from one another very little or not at all, the only distinctions being in the form and proportions of the various parts of the body, and sometimes in the structure of the antennæ. Many of the described species are doubtless distinct and well marked, but I cannot resist the conclusion that not a few have been founded on variable and uncertain characters,—the form and proportions of the abdomen and caudal stylets, for instance, often varying very considerably amongst specimens which, as it seems to me, ought to be referred to a single species, perhaps at different stages of growth or of slightly different race. Between the two sexes there is usually a marked difference of form and colour, the male being generally of a broadly ovate shape, without any distinct constriction or line of separation between abdomen and thorax, and being, moreover, often highly iridescent or opalescent; the females, on the other hand, are devoid of colour, or nearly so, and the abdomen is generally much narrower than the cephalothorax, and separated from it by a distinct constriction. The abdomen is five-jointed in both sexes; the cephalothorax usually also five-jointed, but occasionally the first segment is incompletely (or altogether) divided so as to form a sixth segment. There may be slight sexual differences in the anterior antennæ, and the posterior antennæ are usually more robust and more strongly armed in the male than in the female. The mouth-organs are small and crowded together, consisting of a stout falciform mandible which has ciliated margins but no teeth; a subquadrate, sparingly setiferous maxilla, and two pairs of foot-jaws,—the anterior quite rudimentary, small, and subtriangular, the posterior stouter and simply unguiculate at the apex. The anterior antennæ are usually short and five- or six-jointed, more or less setiferous, and nearly alike in the two sexes; the posterior are larger, stout, prehensile, and strongly clawed; in the female usually more slender and with weaker armature. The eyes are complex, consisting of a small, median, "unpaired" eye, somewhat vesicular in appearance, and of two much larger "paired" or "lateral" eyes, each of which is composed of an anterior conical lens and a posterior more or less distant vitreous body, with which is connected a long, fusiform, and variously-coloured pigment body.

The nervous system, owing to the considerable size and frequent glassy transparency of the animals, is much more plainly visible than in most Copepoda, and consists of a large central ganglion lying a little behind the eyes, and giving off numerous branches to the limbs, viscera, and tegumentary structures.

The alimentary apparatus—stomach, intestine, and liver—and the generative organs in both sexes occupy a large part of the body-cavity, but call for no special remark here. Indeed in spirit-hardened specimens the internal structure becomes almost totally obscured and unfitted for minute examination. Haeckel has proposed to divide the genus *Saphirina*, into two sub-genera,—*Pyromma* (or *Saphirina* proper), and *Cyanomma* (or *Saphiridina*), the following being the characters on which the separation is based.

Sub-genus: PYROMMA (*Saphirina*). Paired eyes having yellow, red, or brown pigment bodies, with corneal lenses placed in the middle or far back. The two last joints of the posterior antennæ together shorter than the elongated second joint. Inner branches of the fourth pair of feet well developed, and as large as those of the other feet.

Sub-genus: CYANOMMA (*Saphirinida*). Paired eyes having violet, blue, or bluish-black pigment bodies, with corneal lenses placed quite on the front of the head. The two last joints of the posterior antennæ together as long as or longer than the very short second joint. Inner branch of the fourth pair of feet rudimentary, its three joints together scarcely longer than the first two joints of the outer branch.

But these characters, though interesting, do not seem to me by any means of sufficient importance to warrant their being taken as the basis of new sub-genera. They have, in fact, not the slightest correlation, being associated or dissociated in the most variable manner. For instance, while the two species here referred to Dana's *Saphirina inæqualis* and *Saphirina ovalis*, have the inner branch of the fourth foot short, the eyes frontal, and the pigment bodies blue, *Saphirina metallina*, with frontal eyes and blue pigment bodies, has the inner branches of all the feet as long or longer than the outer; these three species, therefore, cannot be assigned to either of the sub-genera proposed by Haeckel. It is curious, too, that amongst the many specimens examined by Haeckel no females of any species were seen.

1. *Saphirina ovalis*, Dana (Pl. XLVII. figs. 1–12).

Saphirina ovalis, Dana, Crust. U. S. Expl. Exped. (1852), p. 1246, pl. lxxxvii. fig 10.
„ *detonsa* (?) Id. Ibid. p. 1247, pl. lxxxvii. fig. 11.

Length, 1-10th of an inch (2·55 mm.) Anterior antennæ (figs. 3, 4) five-jointed, the second joint longer than the following three put together; the whole limb is rather densely setiferous on its upper margin, and in the *male* (fig. 3) the last three joints bear, instead of setæ, rather stout spine-like appendages. The posterior antennæ (figs. 5, 6) have the last two joints about equal in length to the second joint; in the *male* they are stouter than in the *female*, and the second joint is armed on its inner margin with a spine. The swimming feet are short and broad, and those of the fourth pair (fig. 10) have the inner branch very small, not exceeding in length the first two joints of the outer branch. The fifth foot (fig. 11) consists of one joint, about thrice as long as broad, and bearing two unequal apical setæ; the last thoracic somite, to which those feet are attached, is in the *female* very small. The second, third, and fourth abdominal segments (fig. 12) are in the *female* imbricated or lunate at the sides, the first is small, the second much wider, the rest gradually decreasing in width to the last; caudal stylets elongated ovate, more

than twice as long as broad; two short setæ on the outer margin, and two at the external apical angle; internal apical angle produced into a distinct tooth. Lateral eyes closely approximated, and situated quite on the front of the head; pigment bodies dark blue. In some specimens, as shown in fig. 2, the integument contains numerous bead-like rows of rounded vesicular or glandular bodies, and these are symmetrically disposed on each side of the body.

Habitat.—Taken in the towing-net in many places:—Off Kandavu, Fiji; between Api and Cape York; south of Papua; between the Arrou Islands and Banda; at several Stations amongst the Philippine Islands; in lat. 36° 32′ S., long. 132° 52′ W. (Station 287); in lat. 32° 24′ S., long, 13° 5′ W. (Station 335); off St. Vincent, Cape Verde Islands; in lat. 25° N., long. 33° W.

Though not unfrequent in the Challenger gatherings, the specimens which came under my notice were, almost without exception, females, and I am therefore doubtful as to the accuracy of some parts of the foregoing description of the male. Having had the opportunity, since the plate was lithographed, of examining further specimens, I am disposed to think that fig. 1 has been drawn from a young individual. Adults are longer, the proportion of length to breadth being as two and a half to one. The margins of the abdominal segments are sometimes very minutely serrated, and the front of the head is always rounded. The lateral angles of the abdominal segments in the male are sometimes minutely mucronate.

2. *Saphirina inæqualis*, Dana (Pl. XLVIII. figs. 1–5).

Saphirina inæqualis, Dana, Crust. U. S. Expl. Exped. (1852), p. 1244, pl. lxxxvii. fig. 7.
,, *elegans* (♀), Lubbock, On some Oceanic Entomostraca collected by Capt. Toynbee, Trans. Linn. Soc., vol. xxiii. p. 12, pl. xxix. figs. 18, 19.
,, *nitens* (♂), Lubbock, *loc. cit.*

Female.—Length, 1-10th of an inch (2·55 mm.) The third cephalothoracic segment is much narrower (from side to side) than the first two, but the fourth is again wider, and is produced at the angles into two more or less obtusely triangular projections;[1] the fifth segment is very short and narrow, scarcely wider than the first abdominal segment. The five abdominal segments are of nearly equal length, but the first is not so wide as either the second or third, and is not "lunate"; the second, third, and fourth are lunated, and the fifth abruptly truncated. The caudal lamellæ are quite twice as long as broad, ovate, scarcely at all toothed at the inner apical angle, which bears a small seta; there are two apical and two external lateral setæ. The whole length of the abdomen, inclusive of caudal lamellæ, is equal to about half that of the cephalothorax. The first cephalo-

[1] In the figure (Pl. XLVIII. fig. 2) the fourth segment is drawn as wide as the third; this is sometimes the case, but in the majority of instances it seems to be as described in the text.

thoracic segment often shows traces of an imperfect division into two. Anterior antennæ six-jointed, posterior rather slender, united lengths of the last two joints about equal to the second joint, claw rather long and slender. The eyes are slightly separated, the pigment bodies deep violet in colour. The *male* is elongate-ovate in shape, the second, third, and fourth joints of the abdomen are lunated, but the angles are neither mucronate nor crenulated.

Habitat.—In lat. 33° 31′ S., long. 74° 43′ W. (Station 299); lat. 41° 54′ S., long. 54° 48′ W. (Station 319); lat. 36° 9′ S., long. 48° 22′ W. (Station 324); lat. 37° 3′ S., long. 44° 17′ W. (Station 326); lat. 5° 28′ N., long. 14° 38′ W. (Station 349); lat. 7° 33′ N., long. 15° 16′ W. (Station 350); lat. 10° 55′ N., long. 17° 46′ W. (Station 352); between Api and Cape York; off Port Jackson, Australia; off Sibago Island, and at other Stations amongst the Philippine Islands.

3. *Saphirina reticulata*, n. sp. (Pl. LI. figs. 12–14).

Male.—Length, 1-10th of an inch (2·55 mm.). Shape broadly ovate, length to breadth as one and three-quarters to one; forehead flattened and distinctly angulated at its junction with the lateral margin, marginal angles of all the segments obtuse; fourth abdominal segment lunated. Caudal lamellæ scarcely twice as long as broad, ovate, inner margin ending in a distinct tooth; setæ equal, short, two apical and two on the external margin. Anterior antennæ short, composed of five nearly equal joints, and bearing only a few very short setæ; posterior longer, finger about as long as the second joint, and having a rather long and slender apical claw. Inner branch of fourth pair of feet half the size of the outer branch. Conspicilla separate. Integument (except the caudal lamellæ) reticulated throughout; reticulations large, irregularly angular, and with beaded sutures. Under a high microscopic power the skin has a finely cross-hatched appearance, reminding one of shagreen or of the grounding of a mezzotint engraving. This peculiar skin-structure I have not seen in any other species. Colour deep brown.

Habitat.—South Atlantic; in lat. 41° 54′ S., long. 54° 48′ W. (Station 319); and lat. 35° 25′ S., long. 23° 40′ W. (Station 132).

4. *Saphirina serrata*, n. sp. (Pl. XLIX. figs. 1, 2).

Female.—Length, 1-12th of an inch (2·1 mm.). Cephalothorax five-jointed, very broad and subtruncate in front, obscurely angulated at the union of the anterior and lateral margins, posterior angles rounded off; last segment very small, rounded. Abdomen five-jointed, the segments of nearly equal length, second, third, and fourth lunated and finely serrated (as also the fifth) on the posterior margins. Caudal lamellæ

elongate-ovate, equal in length to the last three abdominal segments, inner margin ending in a small spine-like seta; two setæ on external margin, and two at apex. Eyes contiguous. In the *male* the posterior angle of each abdominal segment is produced into a minute tooth; the segments are not marginally serrated, but the last three bear median crests, which are minutely serrated at the extremities.

Habitat.—Off St. Vincent, Cape Verde, April 26, 1876; in lat. 13° 50′ S., long. 151° 49′ E. (Station 181).

This I know only from two or three imperfectly observed specimens, but the characters are so well marked as to leave no doubt of its specific distinctness.

5. *Saphirina opalina*, Dana (Pl. XLIX. figs. 3–6).

Saphirina opalina, Dana, Crust. U. S. Expl. Exped. (1852), p. 1254, pl. lxxxviii. fig. 4.
„ *thomsoni*, Lubbock, Trans. Linn. Soc., vol. xxiii. p. 186, pl. xxix. fig. 22, 23.

Female.—Anterior antennæ five-jointed, clothed with very short setæ; terminal claw of posterior antenna suddenly much narrower than the joint to which it is attached. Abdomen short and broad, five-jointed, all the joints of about equal length, first and last narrower than the rest, second, third, and fourth, strongly lunated, with acute tips. Caudal lamellæ subquadrangular, about as long as broad, internal apical angle produced into a large triangular spine, distal margin three or four times sinuated, with sharp points of separation. Inner branch of the fourth pair of feet half as long as the outer branch.

Habitat.—Both specimens figured in the plate were taken amongst the Philippine Islands; Professor Dana's and Sir John Lubbock's were from the tropical Atlantic.

Judging from the peculiarities of the posterior antennæ and caudal lamellæ, there can be no doubt that both the figured specimens belong to the same species; but in the very imperfect separation of the joints of the antennæ and limbs in the smaller specimen, the imperfect subdivision of the first cephalothoracic segment, and still more in the presence of only four (instead of five) abdominal rings, I am disposed to think we have indications of an earlier stage of growth. It is probable also that the example described by Dana—having the body composed only of eight joints—was not fully grown. The thorax of the larger specimen was lost in the process of dissection, and thus escaped observation, and the caudal setæ were broken or imperfect.

The antennæ and abdomen, figured at 4 *a* and 5 *a*, seem to be those of a male *opalina*, and belong to a specimen taken in the same locality as the rest. If the antenna be not malformed, it is a very peculiar one; the difference of the abdominal segments may also be a sexual one.

6. *Saphirina opaca*, Lubbock (Pl. XLIX. figs. 14–17).

Saphirina opaca, Lubbock, Trans. Entom. Soc., vol. iv. pl. v. figs. 9–11.

Female.—Length, 1-8th of an inch (3·1 mm.). Body elongated, about thrice as long as broad; abdomen half as long as cephalothorax, five-jointed, first segment narrow and rounded; second, third, and fourth lunate, fifth truncate, all of about equal length; caudal lamellæ ovate or subquadrangular, about twice as long as broad, equal in length to the last three abdominal segments, inner apical angle produced and acute; cephalothorax six-jointed; first joint short, next four about equal in size, and having rounded margins, sixth very small and rounded. Anterior antennæ (fig. 14) five-jointed, bearing numerous setæ, which are much shorter than the limb itself; first joint very long, equal to the other three; fingers of the posterior (fig. 15) antenna shorter than the second joint; claw short. Marginal spines of the swimming feet (fig. 16) very short and wide; branches of the fourth pair equal. Eyes contiguous.

Habitat.—South Atlantic, in lat. 41° 54′ S., long. 54° 48′ W.

Only a few examples of this species were seen, all females, and though they differ somewhat, especially as to the numbers of thoracic and abdominal segments, from Sir John Lubbock's specimen, they are in other respects so closely similar that I can scarcely doubt their identity with that form. The caudal lamellæ were seen as above described only in the largest of four specimens. In the rest the conspicuous apical tooth was absent, but its outline was indicated within the true margin, so that I suppose it would have been fully developed after the next moult. The limbs, both antennæ and swimming feet, are all extremely small, very much shorter than in any other species known to me.

7. *Saphirina splendens*, Dana (Pl. XLIX. figs 11–13).

Saphirina splendens, Dana, Crust. U. S. Expl. Exped. (1852), p. 1246, pl. lxxxvii. fig. 9.

I have noticed three specimens which, from the shape of the caudal lamellæ, seem to belong to this species; but as the abdomen of the *female* is only three-jointed (fig. 11), I suppose that they are probably immature animals. The gatherings in which they occurred were got off Port Jackson, and at Station 299, lat. 33° 31′ S., long. 74° 43′ W.; depth, 20 fathoms.

The specimens, being mounted for the microscope, were not dissected.

8. *Saphirina gemma*, Dana (Pl. XLVIII. figs. 6–8, and Pl. L, fig. 18).

Saphirina gemma, Dana, Crust. U. S. Expl. Exped. (1852), p. 1252, pl. lxxxviii. figs. 1, 2.

Female.—Length, 1-8th of an inch (3·1 mm.). A large species, much narrower and more elongated than any of the preceding; nearly four times as long as broad, with the thorax not much wider than the abdomen; angles of the thoracic segments a little

produced, the second, third, and fourth abdominal segments lunate, but not very strongly so; first short, second, third, and fourth longer and nearly equal, fifth about half as long again as the preceding, and sharply truncated; caudal lamellæ subovate, nearly thrice as long as broad, and equal in length to the last two abdominal segments, two short external lateral setæ and two longer ones on the apex. Anterior antennæ (fig. 7) five-jointed, the second joint as long as all the rest together; setæ numerous and short; posterior antennæ (fig. 8) stout, the last two joints only about half as long as the second joint; terminal claws short, branches of the fourth pair of feet equal.

The *male* is in shape a long oval, about twice and a half as long as broad, and the last two joints of the posterior antennæ are long and slender, equalling in length the second joint.

Habitat.—South Atlantic, February 12, 1876 (Station 319); between Sydney and Wellington; off Zamboanga; and in the North Atlantic, April 27, 1876.

My description and drawing of the posterior antenna of the female differs altogether as regards the length of the "finger" from that given by Dana; but having verified it by the dissection of two specimens, I am obliged to let it stand; in all other respects Dana's observation agrees with mine, and in the male I find the posterior antenna to be of the slender type. Of course it is possible that I may be wrong in referring the female specimens to *Saphirina gemma*, but their accurate agreement with the types, except in this one particular, for the present at any rate, prevents my calling them by any other name. From the spirit-specimens I cannot say what the original colour may have been, except that some of the females are very opaque and dark-coloured, while Dana's were colourless. The number observed was altogether very small. The spines of the swimming feet (Pl. XLV. fig. 18) are peculiar, being very short and broad at the base, and strongly divaricate, while one side (especially in the case of the apical spines) merges into a finely serrated basal convexity.

9. *Saphirina metallina*, Dana (Pl. L. figs. 11–17).

Saphirina metallina, Dana, Crust. U. S. Expl. Exped. (1852), p. 1242, pl. lxxxvii. fig. 5.
„ *cylindrica*, Lubbock, On some Oceanic Entomostraca collected by Capt. Toynbee, Trans. Linn. Soc., vol. xxiii. p. 184, pl. xxix. figs. 13–15.

Female.—Length, 1-11th of an inch (2·3 mm.). Cephalothorax elongated, the last joint much narrower than the rest (one-third to one-fourth of the width); first segment incompletely divided into two; fourth produced behind into two broadly triangular wings; fifth as long as the preceding, but narrow and rounded at the angles; abdomen five-jointed, narrow, segments nearly equal in length; first very narrow, with rounded angles; second, third, and fourth wider and strongly lunate; fifth truncated, and very finely ciliated on the posterior margin. Caudal lamellæ quadrate, with nearly straight

sides and abruptly truncated apex, nearly as long as the last three segments; one short seta on external margin, one at the angle, and two much longer at the apex; one small seta also attached to the face of the lamina, not far from the inner angle. Anterior antenna (fig. 13) six-jointed, setæ numerous and longer than the limb; finger of posterior antenna (fig. 14) equal in length to the second joint; basal joint produced at the inner distal angle, which is armed with two long but rigid setæ; second joint elongated, slender, its inner border slightly convex and bearing a short, almost lancet-shaped seta near the base; third joint rudimentary, oblique, and bearing two very small setæ; last joint very long, slender, and produced into a slightly curved, awl-shaped apex; its outer margin bears, near the middle, two very minute setæ. Branches of the fourth pair of feet nearly equal in size (fig. 15), marginal spines lancet-shaped and finely serrated; fifth pair almost obsolete (fig. 16, *a*,*a*), consisting of a tubercle with two setæ. Eyes (fig. 17) coalescent. The shape of the *male* (fig. 11) is oblong oval, about thrice as long as broad, almost equal in width throughout, and scarcely at all tapered either in front or behind; the first four abdominal segments are lunated and very much imbricated.

Habitat.—Lat. 17° 54′ N., long. 117° 14′ E. (Station 206); lat. 3° 10′ N., long. 14° 51′ W. (Station 348); lat. 9° 9′ N., long. 16° 41′ W. (Station 351); lat. 5° 45′ S., long. 14° 25′ W. (Station 345); off south coast of Papua; in Mid-Atlantic, August 23, 1873, and in Mid-Pacific, September 1, 1875.

The characters of this species are so peculiar as to make it quite unmistakable amongst the known forms of *Saphirina*. The quite abnormal posterior antennæ and caudal lamellæ are of themselves sufficient, but the lancet-shaped spines of the swimming feet, and the unusually long setæ of the anterior antennæ are valuable subsidiary characters.

10. *Saphirina sinuicauda*, n. sp. (Pl. XLIX. figs. 7–10).

The *female* has a five-segmented abdomen (fig. 9), the first and last segments being small, with rounded angles; the second, third, and fourth lunate; caudal segments ovate, as long as the last four segments, broad at the base and tapered at the apex; inner angle strongly toothed, and deeply excavated behind the tooth; setæ very short and slender; posterior antenna slender, finger as long as the second joint; branches of the fourth pair of feet equal in length; conspicilla contiguous. The *male* has the abdominal segments (fig. 10) almost straight, and their posterior lateral angles very faintly mucronate; the inner branch of the second (?) swimming foot (fig. 8) is armed at the apex with several strong, curved spines, the innermost forming a hook; caudal lamellæ almost exactly as in the *female*.

Two specimens only of this species have been observed, both from the Philippine Islands. The characters of the caudal appendages seem to separate it quite conclusively from any other described species, nor have I seen elsewhere in this genus any structure

like that of the swimming foot figured in the plate. From the similarity of armature, existing in the second foot of some male Harpacticidæ, I suppose this organ to be also the second swimming foot, but as the peculiarity was not noted until after the separation of limbs from body, I cannot be quite sure.

11. *Saphirina angusta*, Dana.

Saphirina angusta, Dana, Crust. U. S. Expl. Exped. (1852), p. 1240, pl. lxxxvii. fig. 3.

Two specimens, apparently belonging to this species, from off Tristan da Cunha, but too much distorted for description, occur on a microscopic mounting made on board.

Saphirinella, Claus.

Saphirinella, Claus, Die frei lebenden Copoden, 1863.
Hyalophyllum, Haeckel, Beiträge zur Kenntniss der Corycæiden, 1864.

Body oval, extremely flattened, quite transparent, colourless or slightly opalescent. Body-segments like those of the male *Saphirina*, but with a very rudimentary fifth segment and feet. Inner branch of the fourth pair of feet one-jointed; fifth pair simple and bearing two setæ. Mouth-organs distant and rudimentary, except the posterior foot-jaws, which are armed with strong prehensile claws. Eyes having a common pigment mass with lateral and median lenses, sometimes a small unpaired eye-spot connected with the pigment body. No corneal lenses (conspicilla); caudal stylets very long and slender, linear.

Of this genus very few specimens came under my notice, and these were generally more or less damaged, so that I have not had the opportunity of dissecting the animal very minutely. On this account I have preferred to borrow the generic definition given above from the work of Dr. Claus on the Copepod-fauna of Nice, a memoir in which the characters of this genus and its relation to Haeckel's *Hyalophyllum* are discussed at considerable length. Dr. Claus concludes that the two genera are identical, and in this conclusion I entirely agree. The specimens observed in the Challenger gatherings appear all to belong to the same species, *Saphirina stylifera*, Lubbock; but another species very closely resembling it is admitted by Haeckel and Claus,—*Saphirina vitrea* (*Hyalophyllum vitreum*, Haeckel).

Saphirinella stylifera (Lubbock), (Pl. XLVII. figs. 13–16, and Pl. XLVIII. figs. 9–13).

Saphirina stylifera, Lubbock, Trans. Entom. Soc., vol. iv. (1856), p. 28, pl. iv. figs. 9, 10.
Saphirinella mediterranea, Claus, Die frei lebenden Copepoden (1863), p. 154, pl. xxv. fig. 12.
„ *stylifera*, Claus, Die Copepoden-fauna von Nizza (1866), p. 17, pl. i. figs. 13, 14.
Hyalophyllum pellucidum, Hæckel, Beiträge zur Kenntniss der Corycæiden (1864), p. 63, pl. i. figs. 1–6, and pl. iii. figs. 31–39.

Male.—Length, 22-100ths of an inch (5·5 mm.). Outline of the body broadly ovate.

Forehead truncated, broad, and emarginate in the middle, posterior extremity narrow, but only slightly tapered. Anterior antennæ (Pl. XLVIII. fig. 10) six-jointed,[1] slender, bearing a few long and slender setæ on the margin and apex; posterior antennæ longer than the anterior, four-jointed, and very slender; first, second, and fourth joints nearly equal in length, third rather shorter, almost devoid of setæ, except that the third joint has three on the margin, the first and second each one, and the last three at the apex; second foot-jaw three-jointed, having a strongly falcate terminal joint; inner margin of second joint having a boss-like dilatation near the apex (fig. 13); anterior foot-jaw (Pl. XLVII. fig. 13) rudimentary. The head and first three thoracic segments usually have a single large oil globule situated near the lateral margin, and the three thoracic segments have likewise each a similar globule in the middle line of the body. The caudal stylets are long, linear, and closely adpressed (Pl. XLVIII. fig. 9, and Pl. XLVII. fig. 14), bearing a very short seta beyond the middle of the outer margin, and two small thorn-like apical setæ. The nervous system (Pl. XLVII. fig. 16) may be seen with great distinctness in the pellucid body of the animal, and consists of a ganglionic central (brain) mass, in which is embedded a pigmented eye-spot; from this centre are given off in all directions numerous nerve-branches, the most conspicuous of these being supplied to the eyes, antennæ, and feet. The genital system (fig. 15) is also very conspicuous, the testis showing as a long fusiform organ on each side, connected by a broad *vas deferens* with the *receptaculum seminis*, which opens into a cloacal pouch.

Habitat.—The gatherings in which this interesting species occurred were from off Kandavu, Fiji; from the North Atlantic, in lat. 5° 28′ N., long. 14° 38′ W.; from the North Atlantic, near Canary Islands (February 2 and 16, 1873); and April 28, 1876, near the same latitude; South Atlantic, in lat. 35° 25′ S., long. 23° 40′ W. (Station 132).

Amongst the distinctive characters insisted on by Haeckel as separating his two species *vitreum* and *pellucidum*, one from the other, are the numbers of joints of the anterior antennæ (four in *pellucidum* and six in *vitreum*), and the situation of the thickened portion of the second foot-jaw (at the apex in *pellucidum*, at the base in *vitreum*). In the Challenger specimens I have found the anterior antenna always six-jointed, except indeed in some instances where the joints could not be very distinctly seen, and where perhaps the limb might have been supposed to be four-jointed; closer observation, however, seemed to reveal, though not very plainly, six joints. As to the structure of the second foot-jaw, I have seen no instance of the basal thickening; so that in these specimens the antennal characters of *vitreum* (according to Haeckel) go with the jaw characters of *pellucidum*. Claus, however, seems to have observed both species, and endorses the characters given by Haeckel. The female is unknown.

[1] The antenna is shown in Plate XLVIII. fig. 10, as having seven joints: this is incorrect; the basal joint should be removed.

Section III. SIPHONOSTOMA, Thorell.

Family I. CALIGINA.

Lepeophtheirus, Nordmann.

Lepeophtheirus, Nordmann, Mikr. Beit.

Fourth pair of feet slender, of only one branch, and serving the animal for walking. Thorax exhibiting only two distinct articulations. Frontal plates destitute of sucking-discs or lunules on their under surface (Baird).

Lepeophtheirus suhmi, n. sp. (Pl. LV. fig. 2).

Length, 16-100ths of an inch (4 mm.). Cephalothorax about twice as long as the rest of the animal, scarcely longer than broad, and not much narrowed in front; frontal region not emarginate in the middle. Antennæ short, first joint of the anterior pair stout and densely setose towards the anterior margin, second joint bearing several short setæ at the extremity; posterior pair directed backwards and having the last joint abruptly hooked at the apex. Furcula deeply cleft, segments slender and curved. Fourth pair of feet reaching to the distal extremity of the genital segment, long, flexuous, and slender, four-jointed, armed with two small lateral and three apical spines, one of which is very long and curved. Genital segment much broader than long, armed with a small spine at each posterior angle. Last abdominal segment and caudal stylets about equal in length, and together equalling only about one-half the genital ring.

The segment to which the third pair of feet is attached is rounded and squamous, and has a small spine at the base of each pair of feet. Between the rostrum and the base of the first foot-jaw, on each side, is a small forked appendage (fig. 2, *a*), in shape very much like the "furcula,"—apparently homologous with the "palp" of some authors, but which I cannot perceive to have any organic connection with either foot-jaw or rostrum. Nearer the margins of the carapace, outside of the first foot-jaws, are two minute hooked appendages (fig. 2, *b*), which enclose in somewhat dilated bases two objects which have the appearance of very small sucking discs.

Found on a *Scarus* taken at St. Vincent, Cape Verde, July 1873.

Echthrogaleus, Steenstr. and Lutk.

Echthrogaleus, St. & Ltk., Snyltekrebs og Lernæer, 1861.
Dinematura, M.-Edw., Dana, not of Latreille nor Kröyer.

First two body segments coalescent; genital segment broad and flat (never long or slender), and deeply emarginate behind; dorsal laminæ large, and covering half of the

genital ring; tail unjointed and hidden under the genital ring; fourth pair of feet small, the basal joint not alæform; first three pairs of feet rudimentary, consisting only of plumose setæ.

Echthrogaleus affinis, M.-Edwards.

A single specimen of this species was found, but the name of the locality has unfortunately been lost.

Pandarus, Leach.

Body broadest in front. Cephalothorax four-jointed; first segment very large, second short, and having alæform lateral processes; third and fourth simple and bilobate. Abdomen two- or three-jointed, rounded behind; caudal stylets borne on the side of the abdomen, acute, styliform, non-setiferous. Eyes two. Four pairs of swimming feet, all two-branched, the fourth pair rudimentary. Sucking discs two (or three) pairs—two pairs on the sides of the carapace, and one at base of second antenna (Dana).

1. *Pandarus cranchii*, Leach (*fide* Steenstrup and Lütken).

Pandarus cranchii, Steenstr. and Ltk., Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernæer, p. 50, Tab. xi. fig. 22.
„ *carchariæ* (Leach ?), Burmeister, Neuen oder weniger bekannten Schmarotzerkrebse, p. 273, pl. xxv.
? „ *armatus*, Heller, Crustacea Novara Exped., p. 202, Tab. xix. fig. 4.
? „ *concinnus*, Dana, Crust. U. S. Expl. Exped. (1852), p. 1366, pl. xcv. fig. 1.

A large number of specimens found parasitic on *Carcharias brachyurus*, between Papua and Japan, and off the Kermadec Islands.

The form and proportions of this animal seem to be subject to a good deal of variation, dependent perhaps upon the age of the specimen; the length and shape of the posterior abdominal segment and caudal stylets are especially variable; and amongst the Challenger specimens are many which I cannot distinguish from Dana's *Pandarus concinnus*. These, however, are lighter in colour, without the conspicuous brown or black blotches of the typical form, somewhat smaller (?), and altogether so different in appearance under the low magnifying power of a hand lens, that I at first set them aside as belonging to a distinct species. This, however, I believe to have been an error; and as Heller's figures of *Pandarus armatus* very closely agree with the "*concinnus*" form, I am disposed to think that this also may fairly be taken as a synonym.

Heller observes that the male of *Pandarus armatus* is unknown, but that *Nogagus*

lattreillii being found in company with it is probably the male—a supposition which is to some extent borne out by anatomical details. It is interesting to note that *Nogagus latreillii* occurs also abundantly in the Challenger gatherings along with *Pandarus cranchii*. Dana's specimens were "from the body of a shark taken south of Tongatabu," Heller's from *Scyllium africanum* at the Cape of Good Hope.

2. *Pandarus satyrus*, Dana.

Pandarus satyrus, Dana, Crust. U. S. Expl. Exped. (1852), p. 1367, pl. xcv. fig. 2.

One specimen, apparently referable to this species, was found in company with the preceding off the Kermadec Islands. It comes very near to Heller's *Pandarus lugubris*.

3. *Pandarus zygænæ*, n. sp. (Pl. LV. fig. 3).

Length, 27-100ths of an inch (7 mm.). Anterior body-segment shorter than its width, irregularly quadrate in form, flattened in front, constricted behind the antennæ and dilated into two alæform processes behind; posterior margin armed in the middle with a series of six stout spines; second segment forming two large lateral wings; caudal laminæ rather wide, oblique at apex, and armed with three sharp, stout spines—two internal lateral and one apical—reaching slightly beyond the rounded terminal lobe of the abdomen. The anterior part of the body is marked with a deep brown blotch, covering the greater part of the segment except for two small transparent points near the centre; the side wings of the second segment are also deeply blotched, as also are the next segment and the terminal abdominal lobe.

Found in considerable numbers upon a specimen of *Zygæna malleus* taken at St. Vincent, Cape Verde Islands.

Perissopus, Steenstr. and Ltk.

Perissopus, St. and Ltk., *loc. cit.*, 1861; ? *Lepidopus*, Dana.

Female.—Cephalothorax undivided; abdominal segments free, and bearing four or six dorsal leaflets; genital segment rather large and broad, covering the very short tail; abdominal feet destitute of plumed setæ, branches of the first and second pair two-jointed; for the rest, inarticulate and quite rudimentary. *Male* unknown.

Perissopus dentatus (Steenstr. and Ltk.).

Perissopus dentatus, St. and Ltk., Bidrag til Kundskab om det aabne Havs Snyltekrebs og Lernæer, p. 53, Tab. xii. fig. 25.

The name of the locality in which this species was taken has been lost.

Alebion, Kröyer.

Alebion, Kröyer, Bidrag til Kundskab om Snyltekrebs, 1863.

Rostrum intermediate in form between that of *Caligus* and *Pandarus*, provided with large and strong palps. First pair of swimming feet two-branched, branches two-jointed; outer branches of the first, second, and third pairs armed with curiously-formed laminæ. Fourth pair rudimentary, two-jointed, one-branched. Carapace produced backwards into two long, narrow processes. Antennal palps, sucking-discs, and furcula wanting.

Alebion carchariæ, Kröyer.

Kröyer, Bidrag til Kundskab om Snyltekrebs, p. 165, Taf. xii. fig. 1.

Found on *Zygæna malleus* at St. Vincent, Cape Verde.

Nogagus, Leach.

This genus differs from *Pandarus* in that the cephalothoracic segments are destitute (or nearly so) of lateral alæ, and are not bilobate; the abdomen is well developed, and its segments distinct; there is no rounded telson, and the caudal stylets are laminar, terminal, and bear setæ of the true Cyclopoid type.

1. *Nogagus grandis*, Steenstr. and Ltk.

Nogagus grandis, St. and Stk., Snyltekrebs og Lernæer, p. 45, Pl. x. fig. 19.

One specimen of this fine species. The memorandum of locality lost.

2. *Nogagus lunatus*, Steenstr. and Ltk.

Nogagus lunatus, ibid. ibidem, p. 49, pl. ix. fig. 17.

From back of *Carcharias glaucus*, Atlantic, March 2, 1876.

3. *Nogagus latreillii*, Leach (*fide* Steenstr. and Ltk.).

Nogagus latreillii, ibid. ibidem, p. 44, pl. ix. fig. 18.

On *Carcharias brachyurus*, between Papua and Japan, and near the Kermadec Islands.

4. *Nogagus curticaudis* (Dana).

Specilligus curticaudis, Dana, Crust. U. S. Expl. Exped., p. 1375, pl. xcv. fig. 6.

On *Carcharias brachyurus*, between Papua and and Japan.

5. *Nogagus validus*, Dana.

Nogagus validus, idem. ibidem, p. 1363, pl. xciv. fig. 9.

On *Carcharias brachyurus*, between Papua and Japan.

6. *Nogagus murrayi*, n. sp. (Pl. LV. fig. 1).

Length, 16-100ths of an inch (4 mm.). Cephalothorax ovate, much longer than broad, and nearly thrice as long as the abdomen: frontal margin rounded, lateral margins somewhat sinuous, posterior angles moderately produced backwards and rounded off. First abdominal (genital) segment about as long as broad, margins round; angles not at all produced nor acute. Two posterior abdominal segments much broader than long, the last pentagonal in shape, and produced backwards between the caudal lamellæ into two obtuse points; caudal lamellæ about as broad as long, subquadrate, each bearing four finely plumose setæ.

Taken in the open sea off Rio de Janeiro, and in the North Atlantic (about lat. 25° N.), April 28, 29, 1876. Very similar to *Nogagus errans*, Kröyer, which, however, differs decidedly in the shape of the last abdominal and two posterior thoracic segments.

Family II. Dichelestidæ.

Hessella,[1] n. gen.

Body much elongated, cylindrical; cephalothorax not much more tumid but longer than the abdomen, which terminates in two blunt adpressed lobes, each bearing three small setæ. Anterior antennæ very small, indistinctly five-jointed (Pl. LV. fig. 10), and densely setose; posterior (fig. 11) small, but stout and hamate. Four pairs of swimming feet, the branches all biarticulate, first and second pairs (fig. 12) two-branched, third and fourth (fig. 13) one-branched.

Hessella cylindrica, n. sp. (Pl. LV. figs. 9–13).

One specimen only taken off Zamboanga.

The species most nearly approaching this seems to be *Clavella tenuis*, Heller, the general characters of some of the appendages being very similar to those of *Hessella*; but the proportions of head, thorax, and abdomen are widely different, as also are the antennæ. I was unable to find any mouth-organs.

Family III. Chondracanthidæ.

Chondracanthus, De la Roche.

Two pairs of foot-jaws, prehensile, the third nearly rudimentary. Appendages of thorax representing the feet, in form digitated, but not articulated, and not setiferous lobes or tubercles, oviferous tubes very short, broad and flattened (Baird).

[1] Named after M. Hesse of Paris, author of numerous memoirs on parasitic Crustacea.

Chondracanthus (?) *macrurus*, n. sp. (Pl. LV. figs. 4–8).

Length, 29-100ths of an inch (7·25 mm.). Body short and stout; head considerably broader than long, broadly rounded in front, and having a long and slender alæform process at each side, directed backwards. Anterior antennæ rather large, projecting much beyond the sides of the head, two-jointed, obtuse and quite destitute of setæ. Abdomen stout, as broad or broader than the head, and about twice as long as the cephalothorax, genital segment short, tail very small and terminating in two minute spines, and reaching about as far backwards as the abdominal lobes. The second cephalothoracic segment has two lateral alæ similar to those of the first segment.

Parasitic on a *Macrurus*, taken at a depth of 600 fathoms, off the Kermadec Islands. One specimen only.

This ought probably to be made the type of a new genus, the mouth-organs being apparently quite different from those of *Chondracanthus*, but my observations of it are so imperfect that it seems best to place it provisionally with *Chondracanthus*.

Family IV. Lernæidæ.

Lernæa, Linné.

Body more or less twisted and outré in appearance. Head furnished with horn-shaped appendages, which are irregularly branched. Ovarian tubes twisted into round masses and placed under the posterior portion of the body. Abdomen of considerable size (Baird).

1. *Lernæa hemiramphi* (?), Kröyer.

Lernæa hemiramphi, Kröyer, Bidrag til Kundskab om Snyltekrebs, p. 318, Tab. xv. fig. 7.

Parasitic on Cavalli taken at St. Vincent, Cape Verde, August 5, 1873.

2. *Lernæa abyssicola*, n. sp.

An interesting species of *Lernæa*, which I propose to call *Lernæa abyssicola*, was observed during the voyage of the Challenger by Dr. v. Willemoes Suhm. The accompanying woodcut is reproduced from his drawing of the living animal, and the following description is taken from his notes.

Lernæa, July 23, 1873, 2400 fathoms; Station 89. On a specimen of the curious Lophioid genus *Ceratias*[1]—an undoubted deep sea form—I discovered a specimen of *Lernæa*, which differs from all other parasitic Copepoda by its transparency. The head of the animal is a simple thread-like prolongation imbedded in the lateral muscles of the fish, and, so far as I was able to trace it, was quite unprovided with differentiated appendages; and I hardly think that they could have got torn off.

[1] The fish here alluded to is described by Sir Wyville Thomson (Voyage of the Challenger, Atlantic, vol. ii. p. 69) as *Ceratias uranoscopus*, Murray; Dr Günther is of opinion that it is specifically identical with *Ceratias holbölli* from Greenland.—J. M.

The head is 4·5 mm. long, and the sack-shaped body 9 mm. long; the latter shows no trace of segmentation or appendages, with the exception of two furcal processes at the end of the body; on the summit of each of these are a few bristles. In the interior of the animal can be distinguished a narrow œsophagus (*oe*) passing into a wide stomach (*st*), which shortly becomes constricted into an intestine (*i*) whose walls are clothed with extraordinarily developed longitudinal muscles (*m*) extending

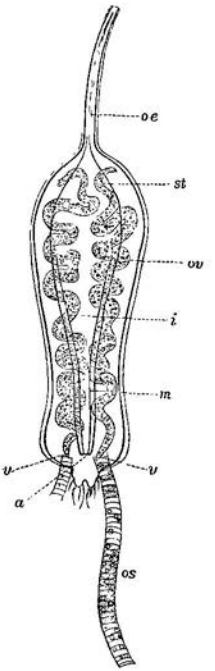


Fig. 4.—*Lernæa* parasitic on *Ceratias* (from a drawing by the late R. v. Willemoes Suhm).
oe, œsophagus; *st*, stomach; *i*, intestine; *m*, muscular portion of intestine; *ov*, ovary; *v*, vulva; *a*, anus; *os*, ovisac.

as far as the anus (*a*); these muscles facilitate the strong sucking movement of the intestinal tract, visible during the life of the animal. In the body cavity are numerous traces of a fat body, and on either side a simple tube-shaped ovary (*ov*), which opens close to the anus. With this vulva (*v*) is connected on either side an ovisac (*os*) containing eggs and large fat globules.

The colour during life was reddish-brown.

My best thanks are due to my friend the Rev. Dr. Norman, for his valuable assistance in the examination and identification of the fish-parasites, and for the opportunity he has kindly afforded me of comparison with specimens in his own collection.

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PLATE I.

PLATE I.

Calanus finmarchicus (Günner).

Fig. 1. Male, seen from the left side, magnified 40 diameters

Fig. 2. Anterior antenna of female.

Fig. 3. Posterior antenna.

Fig. 4. Mandible-palp.

Fig. 5. Mouth with lips.

Fig. 6. Maxilla.

Fig. 7. Posterior foot-jaw of male.

Fig. 8. Posterior foot-jaw of female.

Fig. 9. Foot of fourth pair.

Fig. 10. Fifth pair of feet of male.

G. S. Brady del.

J. Bath, Lith. Edinr.

CALANUS FINMARCHICUS, Gunner.

PLATE II.

PLATE II.

Figs. 1–7. *Calanus propinquus*, n. sp.

Fig. 1. Female, seen from right side.

Fig. 2. Dorsal view of the same, both magnified 16 diameters.

Fig. 3. Anterior antenna.

Fig. 4. Inner branch of posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Foot of fifth pair (serratures distorted).

Fig. 6*a*. Serratures more highly magnified and in natural position.

Fig. 7. One of the caudal stylets with setæ.

Figs. 8–10. *Eucalanus attenuatus*, Dana.

Fig. 8. Maxilla.

Fig. 9. Posterior foot-jaw of female.

Fig. 10. Fifth pair of feet of male.

G. S. Brady del.

F. Roth. Lith^r Edin^r

1-7 CALANUS PROPINQUUS, n. sp. 8-10 EUCALANUS ATTENUATUS, Dana.

PLATE III.

PLATE III.

Figs. 1–7. *Calanus vulgus*, n. sp.

Fig. 1. Female, seen from right side, magnified 24 diameters.

Fig. 2. Anterior antenna of female (joints of swimming feet not quite correct).

Fig. 3. Mandible and palp.

Fig. 4. Foot of fourth pair.

Fig. 5. Fifth pair of feet of male.

Fig. 6. Right fifth foot of male in flexed position.

Fig. 7. Abdomen of male.

Figs. 8–15. *Eucalanus setiger*, n. sp.

Fig. 8. Male, seen from left side, magnified 20 diameters.

Fig. 9. Posterior antenna of male.

Fig. 10. Posterior antenna of female.

Fig. 11. Mandible and palp.

Fig. 12. Foot of fourth pair.

Fig. 13. Foot of fifth pair of male.

Fig. 14. Last two thoracic segments of male, seen from above.

Fig. 15. Abdomen of male.

1-7 CALANUS VALGUS, n. sp. 8-15 EUCALANUS SETIGER, n. sp.

PLATE IV.

PLATE IV.

Figs. 1, 2. *Drepanopus furcatus*, n. gen. and sp.

Fig. 1. Female, seen from right side, magnified 80 diameters.

Fig. 2. Anterior antenna of the same.

Figs. 3–7. *Calanus princeps*, n. sp.

Fig. 3. Female, natural size.

Fig. 4. Anterior antenna of the same.

Fig. 5. Maxilla.

Fig. 6. Portion of seta of anterior foot-jaw, with marginal hairs.

Fig. 7. One of the swimming feet.

Figs. 8–9. *Calanus tonsus*, n. sp.

Fig. 8. Anterior antenna.

Fig. 9. Abdomen (female).

Figs. 10–14. *Ectinosoma atlanticum* (?), Brady and Robertson.

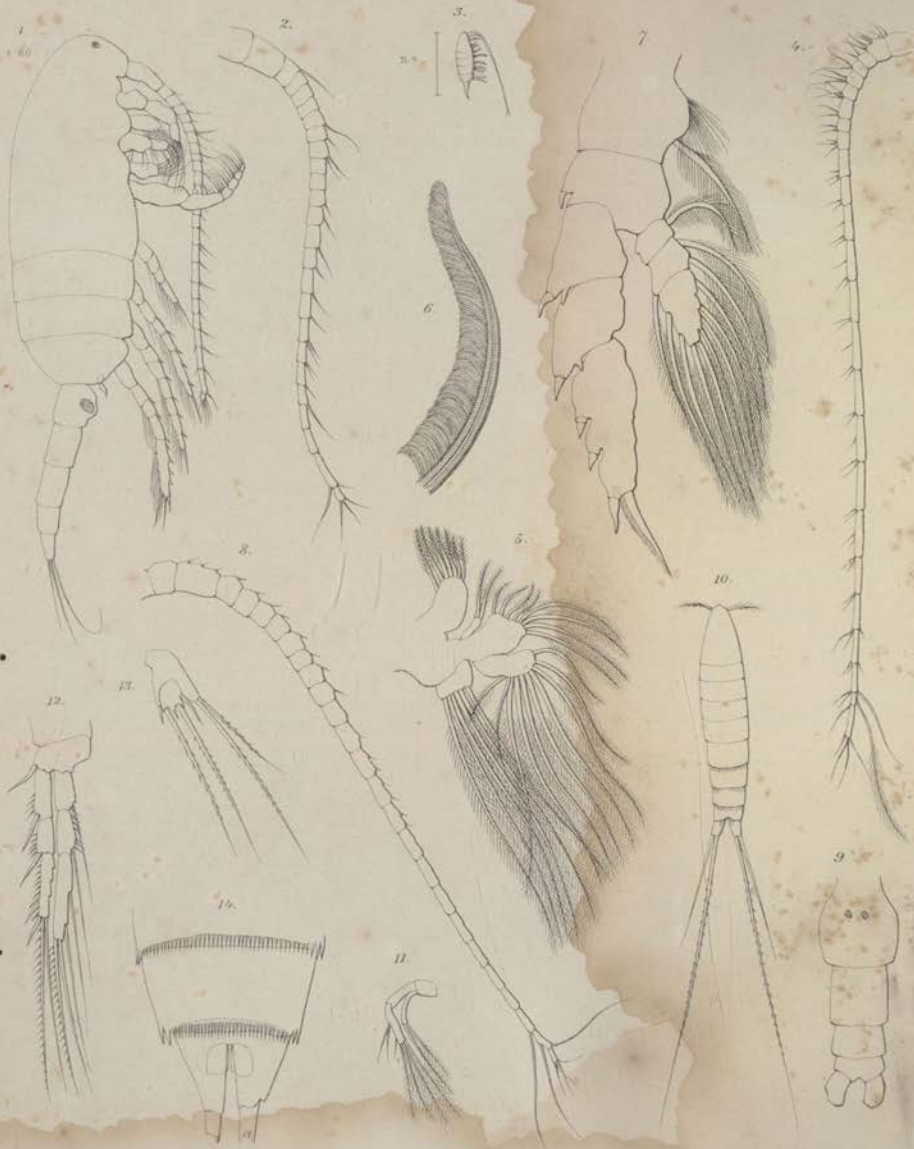
Fig. 10. Female, seen from above, magnified 80 diameters.

Fig. 11. Posterior antenna.

Fig. 12. One of the swimming feet.

Fig. 13. One of the fifth pair of feet.

Fig. 14. Posterior segments of abdomen.



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J. Roh Lith. Edin.

1, 2 DREPANOPUS FURCATUS, n. gen. & sp. 3-7 CALANUS PRINCEPS, n. sp.
8, 9 CALANUS TONSUS, n. sp. 10-14 ECTINOSOMA ATLANTICUM (?) Brady & Robertson.

PLATE V.

PLATE V.

Figs. 1–6. *Calanus gracilis*, Dana.

Fig. 1. Female, seen from above, magnified 20 diameters.

Fig. 2. Maxilla.

Fig. 3. Terminal seta of first foot.

Fig. 4. Foot of fourth pair (female).

Fig. 5. Foot of fourth pair (male).

Fig. 6. Right fifth foot of male.

Figs. 7–16. *Phyllopus bidentatus*, n. gen. and sp.

Fig. 7. Anterior antenna (male ?).

Fig. 8. Mandible.

Fig. 9. Maxilla.

Fig. 10. Anterior foot-jaw.

Fig. 11. Posterior foot-jaw.

Fig. 12. Fifth pair of feet (male ?).

Fig. 13. Posterior thoracic angle and lateral view of abdomen.

Fig. 14. Anterior view of abdomen.

Fig. 15. Terminal spines of one of the swimming feet.

Fig. 16. Rostrum.

1-6 CALANUS GRACILIS, Dana. 7-16 PHYLLOPUS BIDENTATUS, n. gen. & sp.

PLATE VI.

PLATE VI.

Eucalanus attenuatus, Dana.

Fig. 1. Female, seen from right side, magnified 32 diameters.

Fig. 2. Head of the same seen from below; (*r*), rostrum.

Fig. 3. Rostrum.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw of male.

Fig. 8. One of the swimming feet.

G. S. Brady del.

F. Huth, Lith. Edin.

EUCALANUS ATTENUATUS, Dana.

PLATE VII.

PLATE VII.

Rhinculanus cornutus, Dana.

Fig. 1. Female, seen from above, magnified 32 diameters.

Fig. 2. Another specimen, seen from right side, magnified 40 diameters.

Fig. 3. Posterior antenna.

Fig. 4. Mandible and palp.

Fig. 5. Maxilla.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw.

Fig. 8. Foot of first pair.

Fig. 9. One of the swimming feet, second, third, or fourth pair.

Fig. 10. Fifth pair of feet.

G. C. Brady del.

F. Huth, Lith^r Edin^r

RHINCALANUS CORNUTUS, Dana.

PLATE VIII.

PLATE VIII.

Rhincalanus gigas, n. sp.

Fig. 1. Female, seen from right side, magnified 16 diameters.

Fig. 1*a*. Last thoracic segment, seen from below.

Fig. 2. Posterior antenna.

Fig. 3. Mandible and palp.

Fig. 4. Maxilla and palp.

Fig. 5. Anterior foot-jaw.

Fig. 6. Posterior foot-jaw.

Fig. 7. Foot of first pair.

Fig. 8. Foot of fourth pair.

Fig. 9. Fifth pair of feet.

Fig. 10. The same from another specimen.

Fig. 11. Abdomen and tail.

G. S. Brady del.

F. Huth, Lith^r Edin^r

RHINCALANUS GIGAS, n. sp.

PLATE IX.

PLATE IX.

Figs. 1–7. *Hemicalanus longicornis*, Claus.

Fig. 1. Male (?), seen from above, magnified 40 diameters.

Fig. 2. Posterior antenna.

Fig. 3. Mandible and palp.

Fig. 4. Maxilla.

Fig. 5. Anterior foot-jaw.

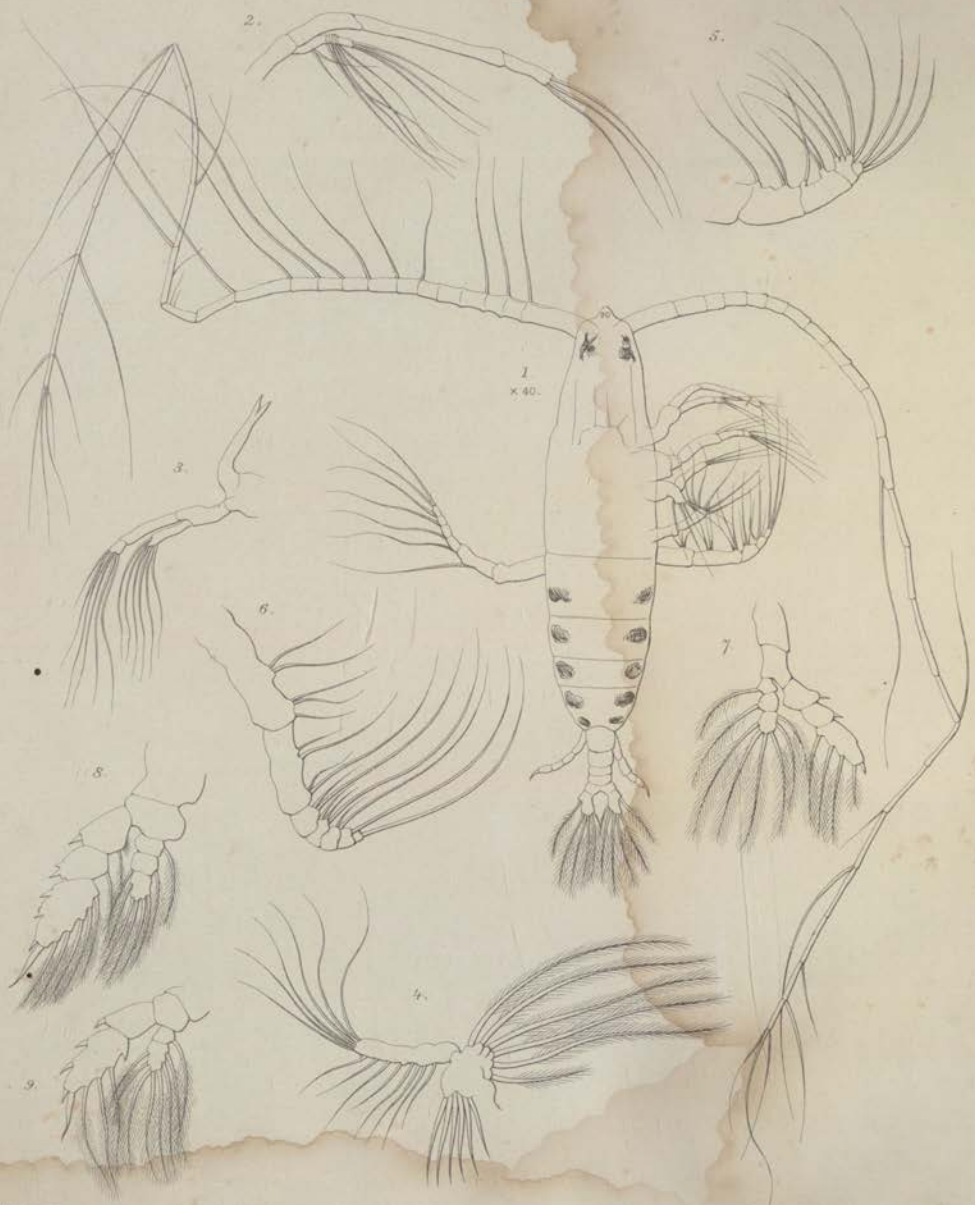
Fig. 6. Posterior foot-jaw.

Fig. 7. Foot of fifth pair (female).

Figs. 8–9. *Hemicalanus orientalis*, n. sp.

Fig. 8. Foot of fourth pair.

Fig. 9. Foot of fifth pair.



G. S. Brady del.

F. Huth, Lith. Xhot.

1-7 HEMICALANUS LONGICORNIS, Claus. 8, 9 H. ORIENTALIS, n. sp.

PLATE X.

PLATE X.

Figs. 1–4. *Hemicalanus orientalis*, n. sp.

Fig. 1. Anterior antenna, magnified 50 diameters.

Fig. 2. Anterior foot-jaw.

Fig. 3. Posterior foot-jaw.

Fig. 4. Abdomen and tail (imperfect).

Figs. 5–16. *Ætidius armatus*, n. gen. and sp.

Fig. 5. Female, seen from right side magnified 50 diameters.

Fig. 6. Anterior antenna.

Fig. 7. Posterior antenna.

Fig. 8. Mandible.

Fig. 9. Anterior foot-jaw.

Fig. 10. Posterior foot-jaw.

Fig. 11. Foot of first pair.

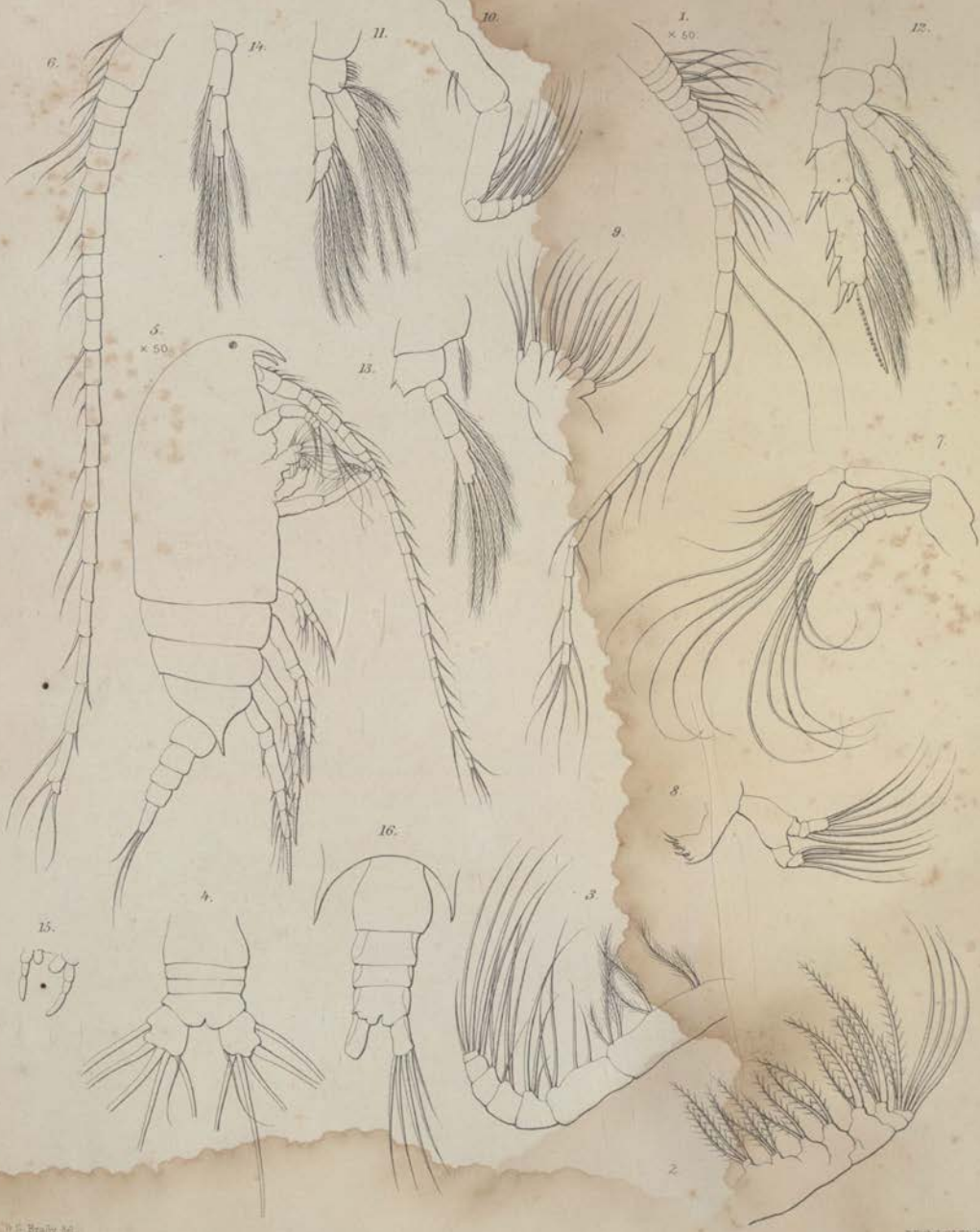
Fig. 12. Foot of second pair.

Fig. 13. Inner branch and base of third foot.

Fig. 14. Inner branch of fourth foot.

Fig. 15. Fifth pair of feet of male.

Fig. 16. Abdomen and posterior thoracic spines of female.



W. S. Brady del. F. Huth, Lith^r Edin^r

1-4 HEMICALANUS ORIENTALIS, n. sp. 5-16 ÆTIDIUS ARMATUS, n. gen. & sp.

PLATE XI.

PLATE XI.

Pleuromma abdominale (Lubbock).

Fig. 1. Adult female, seen from above, magnified 40 diameters.

Fig. 2. Antennal hooks of the same.

Fig. 3. Left anterior antenna of male.

Fig. 4. Right anterior antenna of male.

Fig. 5. Denticulated plate of the same more highly magnified.

Fig. 6. Second foot of left side, male.

Fig. 7. Foot of third pair, male.

Fig. 8. Fifth pair of feet of adult male.

Fig. 9. Fifth pair of feet of immature male.

Fig. 10. Fifth pair of feet of adult female.

Fig. 11. Fifth pair of feet of immature female.

Fig 12. Abdomen of adult male.

Fig. 13. Abdomen of less fully developed (?) male.

G. E. Ready del.

P. Huth, Lith. Edinr.

PLEUROMMA ABDOMINALE, Lubbock.

PLATE XII.

PLATE XII.

Pleuromma abdominale (Lubbock).

Fig. 1. Anterior antenna of female.

Fig. 2. Left anterior antenna of male.

Fig. 3. Mandible.

Fig. 4. Maxilla.

Fig. 5. Anterior foot-jaw, with eye.

Fig. 6. Posterior foot-jaw.

Fig. 7. Foot of first pair.

Fig. 8. Foot of second pair, female.

Fig. 9. Foot of third or fourth pair.

Figs. 10, 11. Fifth pair of feet of male (two different specimens)

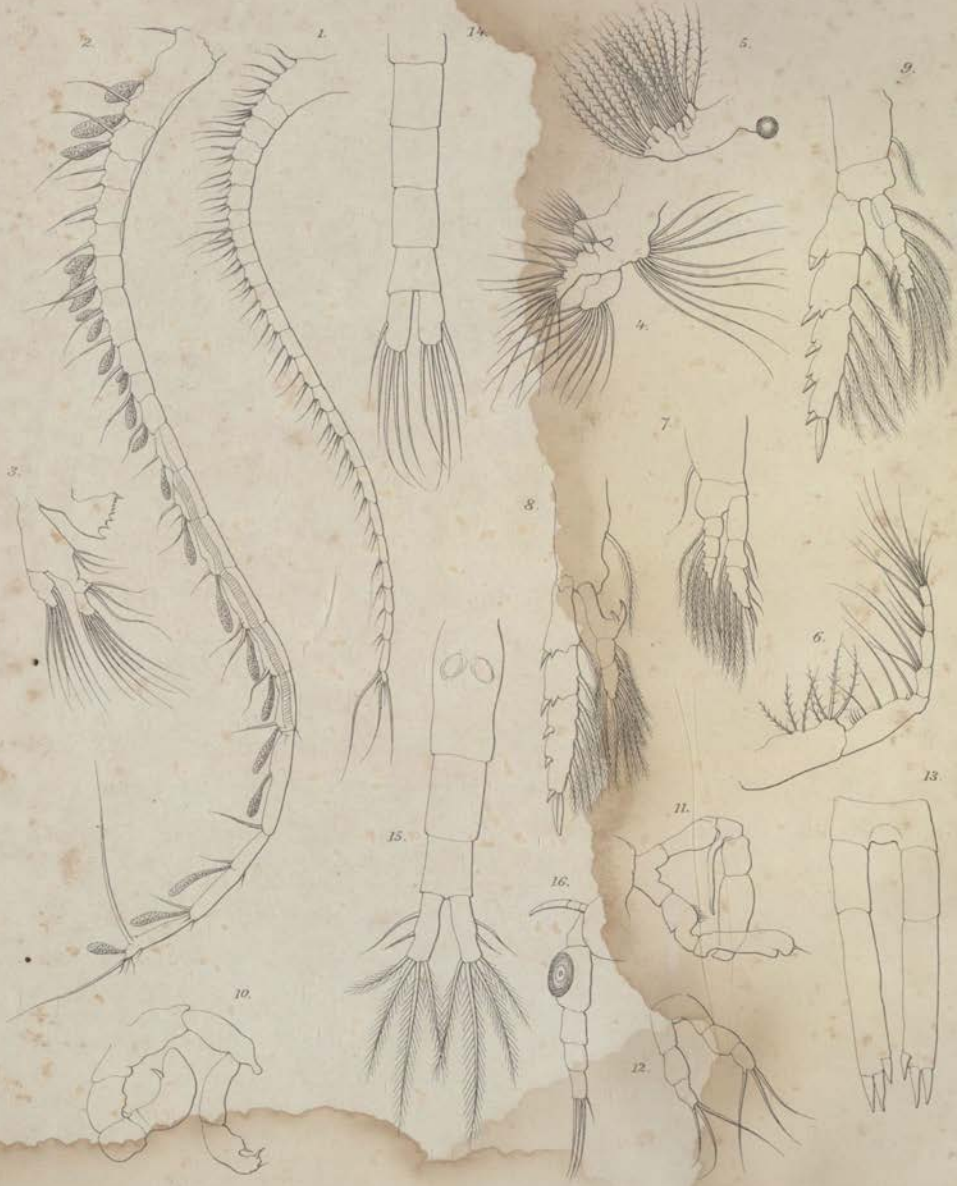
Figs. 12, 13. Fifth pair of feet of female (two distinct stages).

Fig. 14. Abdomen of male.

Fig. 15. Abdomen of female.

Fig. 16. Abdomen of female seen laterally, showing *receptaculum seminis* and fifth pair of feet.

(The figures in this Plate are for the most part drawn from what seems to be an immature form,—identical with *Pleuromma gracile*, Claus.)



G. S. Brady del.

F. Huth, Lith. Edin.

PLEUROMMA ABDOMINALE, Lubbock.

PLATE XIII.

PLATE XIII.

Heterochæta spinifrons, Claus.

Fig. 1. Female, seen from above, magnified 20 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Left anterior antenna of male.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Maxilla.

Fig. 7. Anterior foot-jaw.

Fig. 8. Posterior foot-jaw.

Fig. 9. Outer branch of third swimming foot.

Fig. 10. Fifth pair of feet of male.

Fig. 11. Fifth pair of feet of female.

Fig. 12. Abdomen of female, with spermatophore attached.

Fig. 13. Portion of spermatophore, with spermatozoids, more highly magnified.

G. S. Brady, del.

F. Huth, Lith. Edinr.

HETEROCHÆTA SPINIFRONS, Claus.

PLATE XIV.

PLATE XIV.

Figs. 1–5. *Leuckartia scopularis*, n. sp.

Fig. 1. Right anterior antenna of male.

Fig. 2. Geniculating portion of left anterior antenna of male.

Fig. 3. Foot of the fifth pair, left side (imperfect), male.

Fig. 4. Foot of fifth pair, right side, male.

Fig. 5. Abdomen of male.

Figs. 6–9. *Euchæta pulchra* (Lubbock.)

Fig. 6. Female, seen from left side, magnified 20 diameters.

Fig. 7. Anterior antenna of male.

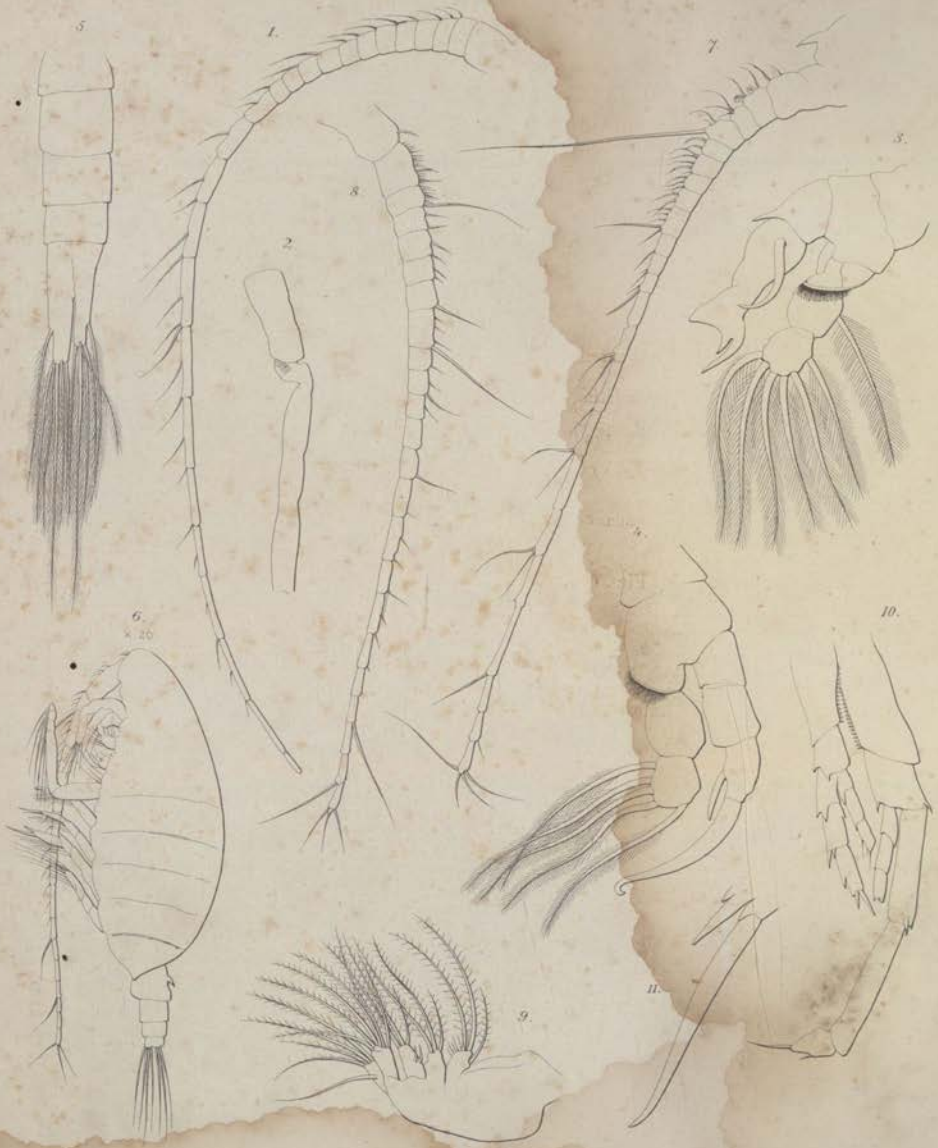
Fig. 8. Anterior antenna of female.

Fig. 9. Anterior foot-jaw of female.

Figs. 10, 11. *Calanus propinquus*, n. sp.

Fig. 10. Fifth pair of feet of male.

Fig. 11. Terminal spines of one of the swimming feet.



G. S. Brady del.

F. Huth, Lith. Edinr.

1-5 LEUCKARTIA SCOPULARIS, n. sp. 6-9 EUCHÆTA PULCHRA, Lubbock.
10, 11 CALANUS PROPINQUUS, n. sp.

PLATE XV.

PLATE XV.

Figs. 1–10, 16. *Leuckartia flavicornis*, Claus.

Fig. 1. Female, seen from left side, magnified 16 diameters.

Fig. 2. Left anterior antenna of male.

Fig. 3. Terminal joints of the same, more highly magnified.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. One of the swimming feet.

Fig. 7. Terminal spines of the same, more highly magnified.

Fig. 8. Right fifth foot of male.

Fig. 9. Left fifth foot of male.

Fig. 10. Abdomen of male.

Fig. 16. Maxilla.

Figs. 11–15. *Undina vulgaris*, Dana.

Fig. 11. Anterior antenna of male.

Fig. 12. Anterior antenna of female.

Fig. 13. Foot of second pair.

Fig. 14. Fifth pair of feet of male

Fig. 15. Abdomen of male.

G. S. Brady del. F. Bath Lith. Edin.

1-10, 16 LEUCKARTIA FLAVICORNIS, Claus. 11-15 UNDINA VULGARIS, Dana.

PLATE XVI.

PLATE XVI.

Figs. 1–4, 6–14. *Undina darwinii*, Lubbock.

Fig. 1. Male, seen from left side, magnified 40 diameters.

Fig. 2. Anterior antenna of male.

Fig. 3. Anterior antenna of female.

Fig. 4. Apical joints of the same, more highly magnified.

Fig. 6. Mandible and palp.

Fig. 7. Maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. Outer branch and base of third swimming foot.

Fig. 11. Right fifth foot of male.

Fig. 12. Left fifth foot of male.

Fig. 13. Abdomen of male.

Fig. 14. Abdomen of female.

Figs. 15, 16. *Scolecithrix minor*, n. sp.

Fig. 15. Fifth pair of feet of male.

Fig. 16. Fifth pair of feet of female.

(The antenna represented in fig. 5 is that of a species of *Calanus* (?*finmarchicus*), and does not properly belong to this plate.)

G. S. Brady del.

F. Huth, Lith. Edin.

1-14 UNDINA DARWINII, Lubbock. 15, 16 SCOLECITHRIX MINOR, n. sp.

PLATE XVII.

PLATE XVII.

Scolecithrix danæ (Lubbock).

Fig. 1. Male, seen from left side, magnified 40 diameters.

Fig. 2. Anterior antenna of male.

Fig. 3. Anterior antenna of female.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Maxilla.

Fig. 7. Anterior foot-jaw.

Fig. 8. Terminal spines of one of the swimming feet.

Fig. 9. Fifth pair of feet of male.

Fig. 10. The same, immature.

Fig. 11. Abdomen of female, seen from front.

Fig. 12. The same seen from left side.

G. S. Brady del.

E. Roth, Lith. Newc.

SCOLECITHRIX DANÆ, Lubbock.

PLATE XVIII.

PLATE XVIII.

Figs. 1–5. *Scolecithrix minor*, n. gen. and sp.

Fig. 1. Female, seen from right side, magnified 55 diameters; *a*, fifth foot.

Fig. 2. Anterior antenna of female.

Fig. 3. Maxilla.

Fig. 4. Anterior foot-jaw of male.

Fig. 5. Anterior foot-jaw of female.

Fig. 6. *Undina vulgaris*, Dana.

Fig. 6. Female, seen from left side, magnified 40 diameters.

Figs. 7–15. *Euchæta prestandreæ*, Philippi.

MALE.

Fig. 7. Male, seen from right side, magnified 16 diameters.

Fig. 8. Anterior antenna.

Fig. 9. Mandible.

Fig. 10. Maxilla.

Fig. 11. Anterior foot-jaw.

Fig. 12. Posterior foot-jaw.

Fig. 13. Fifth pair of feet (adult); *a*, attached spermatophore.

Fig. 14. The same immature (*sutherlandii*, Lubbock).

Fig. 15. Abdomen.

G. S. Brady del.

F. Huth, Lith. Edin.

1-5 SCOLECITHRIX MINOR, n. gen. & sp. 6 UNDINA VULGARIS, Dana.
7-15 EUCHÆTA PRESTANDREÆ, Philippi.

PLATE XIX.

PLATE XIX.

Euchæta prestandreæ, Philippi.

FEMALE.

Fig. 1. Female, seen from above, magnified 20 diameters.

Fig. 2. Female, seen from left side, magnified 40 diameters.

Fig. 3. Posterior antenna.

Fig. 4. Mandible and palp.

Fig. 5. Maxilla.

Fig. 6. Anterior foot-jaw.

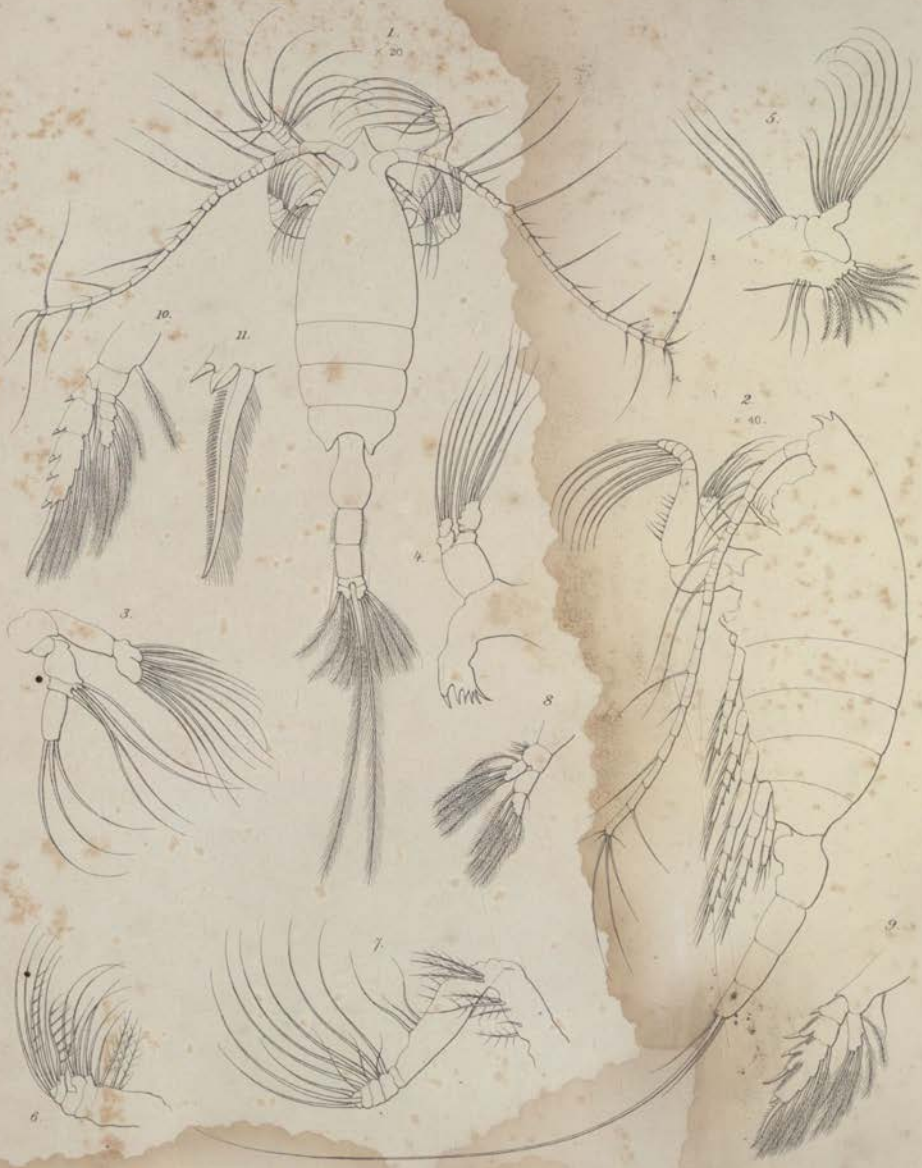
Fig. 7. Posterior foot-jaw.

Fig. 8. Foot of first pair.

Fig. 9. Foot of second pair.

Fig. 10. Foot of third pair.

Fig. 11. Terminal spines of one of the swimming feet.



EUCHÆTA PRESTANDREÆ, Philippi.

PLATE XX.

PLATE XX.

Figs. 1–13. *Euchæta hessei*, n. sp.

Fig. 1. Male, seen from left side, magnified 40 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Posterior antenna.

Fig. 4. Mandible.

Fig. 5. Maxilla of female.

Fig. 6. Maxilla of male.

Fig. 7. Anterior foot-jaw of female.

Fig. 8. Posterior foot-jaw of female.

Fig. 9. Posterior foot-jaw of male.

Fig. 10. Terminal spines of one of the swimming feet.

Fig. 11. Fifth pair of feet of male.

Fig. 12. Abdomen of male.

Fig. 13. Abdomen of female.

Figs. 14–19. *Euchæta pulchra* (Lubbock).

Fig. 14. Maxilla of female.

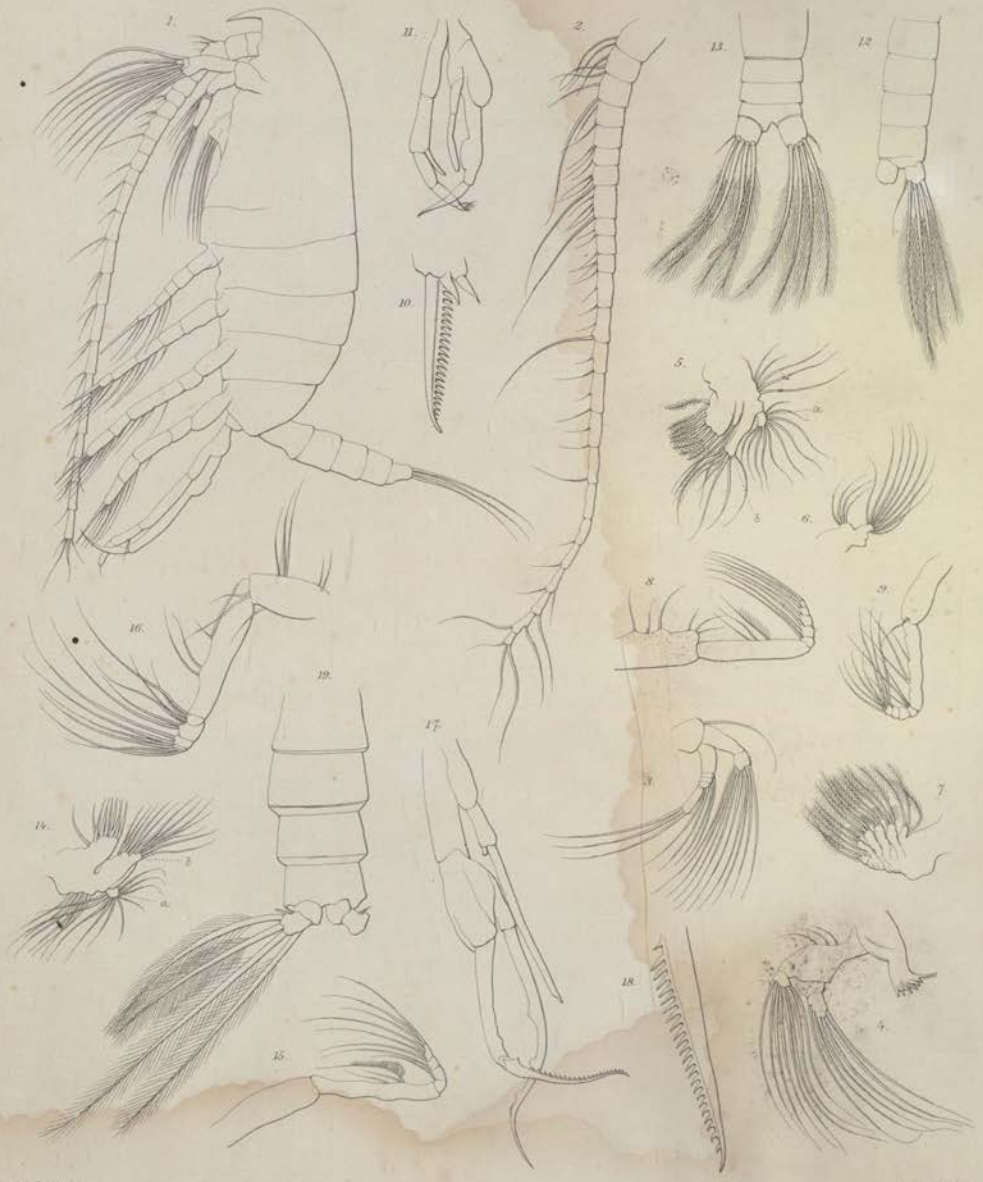
Fig. 15. Posterior foot-jaw of male.

Fig. 16. Posterior foot-jaw of female.

Fig. 17. Fifth pair of feet of male.

Fig. 18. Terminal spine of one of the swimming feet.

Fig. 19. Abdomen of male.



G. S. Brady del. W. Hoth, Lith. Edin.

1-13 EUCHÆTA HESSEI, n. sp. 14-19 E. PULCHRA, Lubbock.

PLATE XXI.

PLATE XXI.

Figs. 1–4. *Euchæta philippii*, n. sp.

Fig. 1. Female (?), seen from right side, magnified 16 diameters.

Fig. 2. Anterior antenna of the same.

Fig. 3. Terminal spines of one of the swimming feet.

Fig. 4. Fifth pair of feet.

Figs. 5–11. *Euchæta australis*, n. sp.

Fig. 5. Female, seen from right side, magnified 32 diameters.

Fig. 6. Anterior antenna of male.

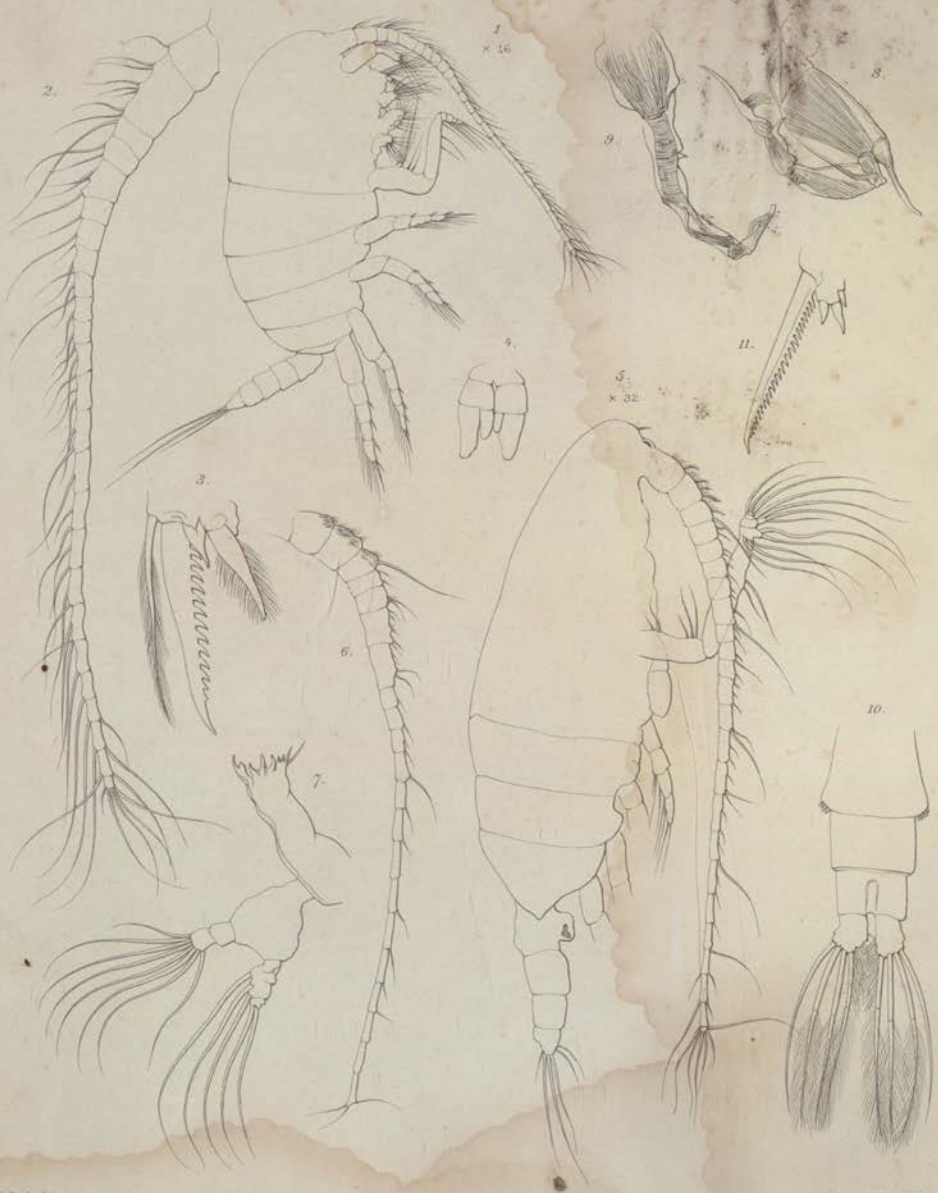
Fig. 7. Mandible and palp of female.

Fig. 8. Right foot of fifth pair of male.

Fig. 9. Left foot of the same.

Fig. 10. Abdomen of female.

Fig. 11. Terminal spines of one of the swimming feet.



G.S. Brady del.

E. Roth, Lith^r Edin^r

1-4 EUCHÆTA PHILIPPII, n. sp. 5-11 E. AUSTRALIS, n. sp.

PLATE XXII.

PLATE XXII

Figs. 1–5. *Euchæta gigas*, n. sp.

Fig. 1. Female seen from above, magnified 16 diameters.

Fig. 2. Anterior antenna.

Fig. 3. Extremity of mandible.

Fig. 4. Terminal spines of one of the swimming feet.

Fig. 5. Fifth pair of feet (? immature male).

Figs. 6–12. *Euchæta barbata*, n. sp.

Fig. 6. Anterior antenna of female.

Fig. 7. Rostrum.

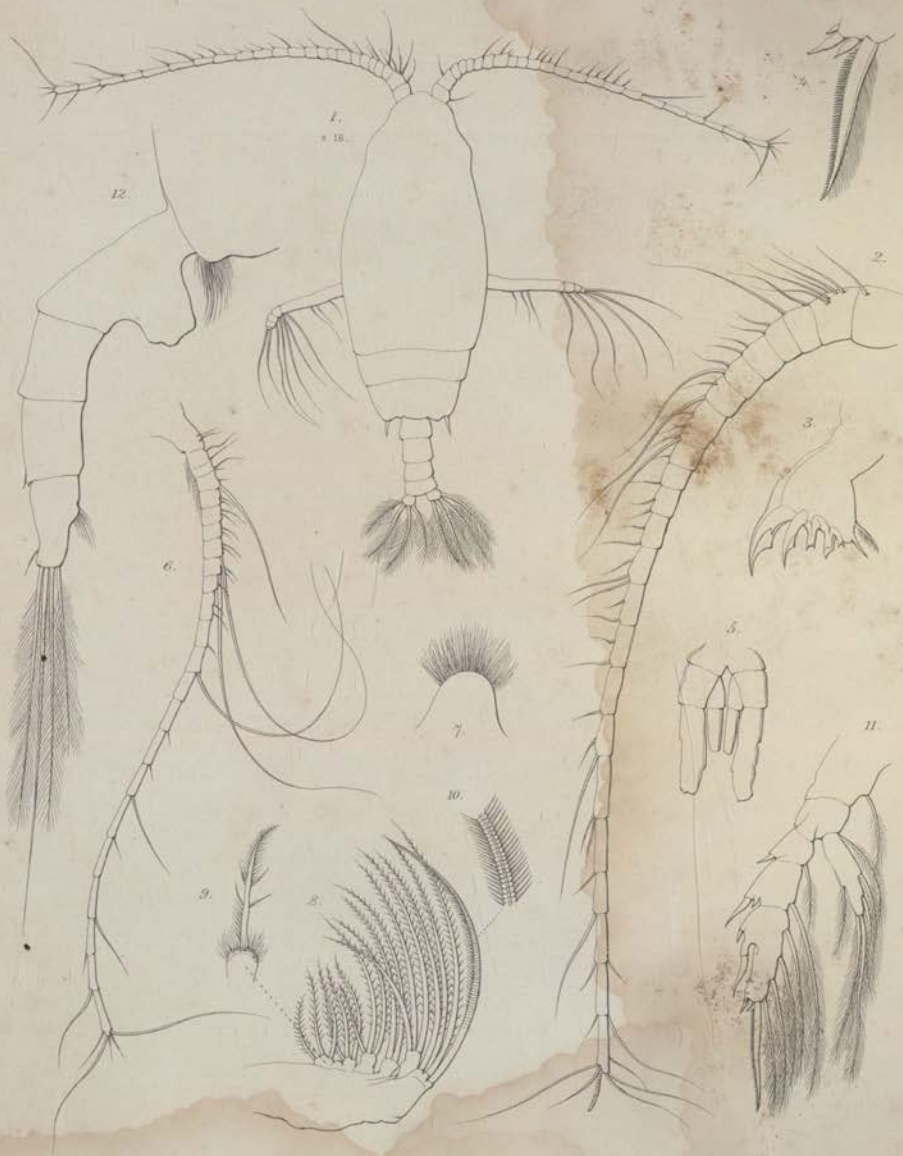
Fig. 8. Anterior foot-jaw.

Fig. 9. One of the proximal setæ of the same, with base.

Fig. 10. Portion of one of the larger setæ of the same, more highly magnified.

Fig. 11. Foot of the second pair.

Fig. 12. Abdomen, with posterior angle of thorax.



G. S. Brady, del.

F. Huth, Lith. Edin.

1-5 EUCHÆTA GIGAS, n. sp. 6-12 E. BARBATA, n. sp.

PLATE XXIII.

PLATE XXIII.

Figs. 1–10. *Calanoides patagoniensis*, n. gen. and sp.

Fig. 1. Male, seen from above, magnified 40 diameters.

Fig. 2. Posterior antenna.

Fig. 3. Mandible of male.

Fig. 4. Mandible of female.

Fig. 5. Maxilla of female.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw of male.

Fig. 8. Foot of third pair.

Fig. 9. Fifth pair of feet of male.

Fig. 10. Abdomen of female.

Figs. 11–14. *Euchæta hessei*, n. sp

Fig. 11. Foot of first pair.

Fig. 12. Foot of second pair.

Fig. 13. Foot of fourth pair (female).

Fig. 14. Abdomen of female, with attached spermatophores.

1-10 CALANOIDES PATAGONIENSIS, n. gen. & sp. 11-14 EUCHÆTA HESSEI, n. sp.

PLATE XXIV.

PLATE XXIV.

Figs. 1–11. *Drepanopus pectinatus*, n. gen. and sp.

Fig. 1. Female, seen from right side, magnified 40 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Anterior antenna of male.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Maxilla.

Fig. 7. Foot of first pair.

Fig. 8. Foot of second pair.

Fig. 9. Foot of fourth pair.

Fig. 10. Fifth pair of feet (female).

Fig. 11. Fifth pair of feet (male).

Figs. 12–15. *Drepanopus furcatus*, n. gen. and sp.

Fig. 12. Foot of second pair.

Fig. 13. Foot of fourth pair.

Fig. 14. Terminal spines of swimming foot.

Fig. 15. Fifth pair of feet (female).

G. S. Brady del.

F. Huth, Lith. Edinr.

1-11 DREPANOPUS PECTINATUS, n. gen. & sp. 12-15 D. FURCATUS, n. gen. & sp.

PLATE XXV.

PLATE XXV.

Temora dubia (Lubbock).

Fig. 1. Male, seen from right side, magnified 50 diameters.

Fig. 2. Right anterior antenna of male.

Fig. 3. Anterior antenna of female.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Maxilla.

Fig. 7. Anterior foot-jaw.

Fig. 8. Posterior foot-jaw.

Fig. 9. Foot of first pair, female.

Fig. 10. Foot of second (and third) pair of female.

Fig. 11. Foot of fourth pair of female.

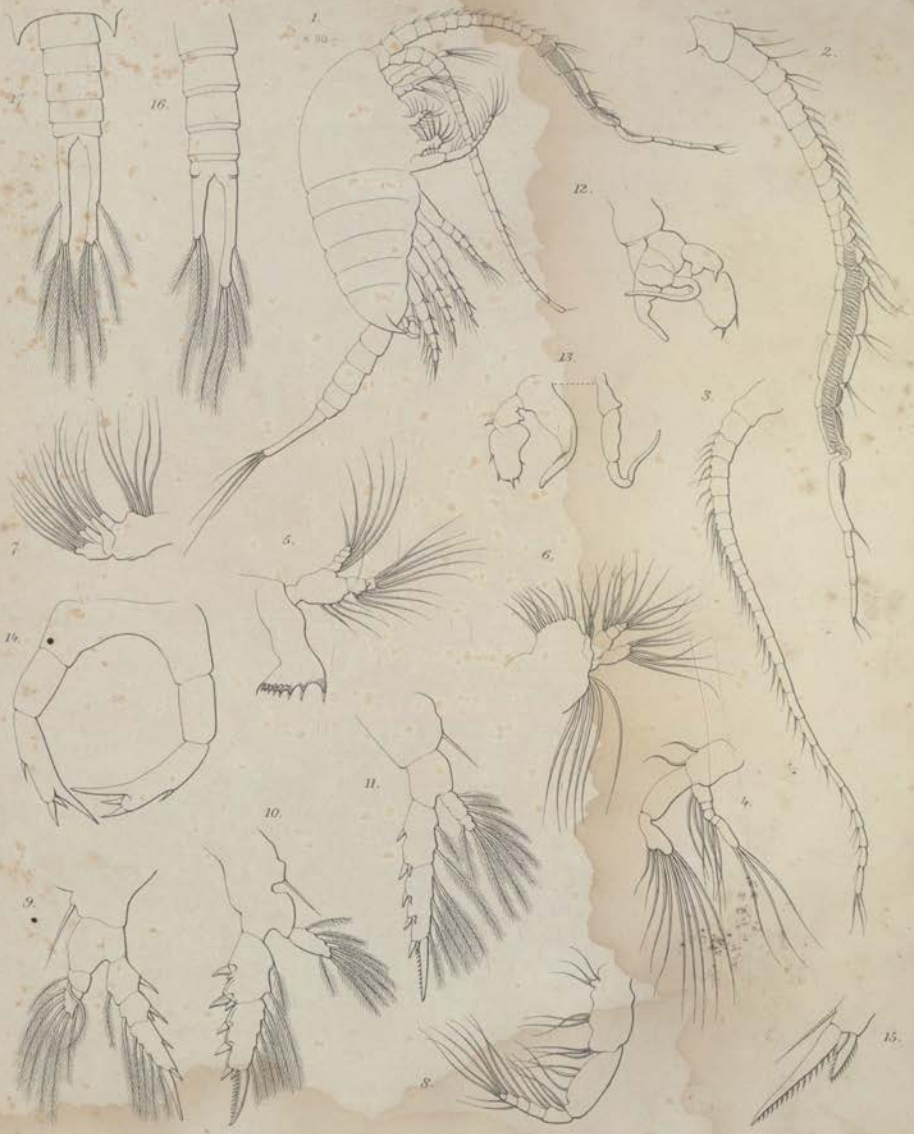
Figs. 12, 13. Fifth pair of feet of male (seen in different positions).

Fig. 14. Fifth pair of feet of female.

Fig. 15. Terminal spines of one of the swimming feet.

Fig. 16. Abdomen of male (monstrosity).

Fig. 17. The same (normal).



G. S. Brady del.

F. Huth, Lith.^r Edin.^r

TEMORA DUBIA, Lubbock.

PLATE XXVI.

PLATE XXVI.

Figs. 1–7. *Centropages brachiatus* (Dana).

Fig. 1. Female, seen from above, magnified 20 diameters.

Fig. 2. Base of anterior antenna of female.

Fig. 3. Right anterior antenna of male.

Fig. 4. Dentated joints of the same, more highly magnified.

Fig. 5. Foot of fifth pair, female.

Fig. 6. Right fifth foot of male.

Fig. 7. Left fifth foot of male.

Figs. 8–15. *Pontella detruncata*, Dana.

Fig. 8. Left anterior antenna of male.

Fig. 9. Right anterior antenna of male.

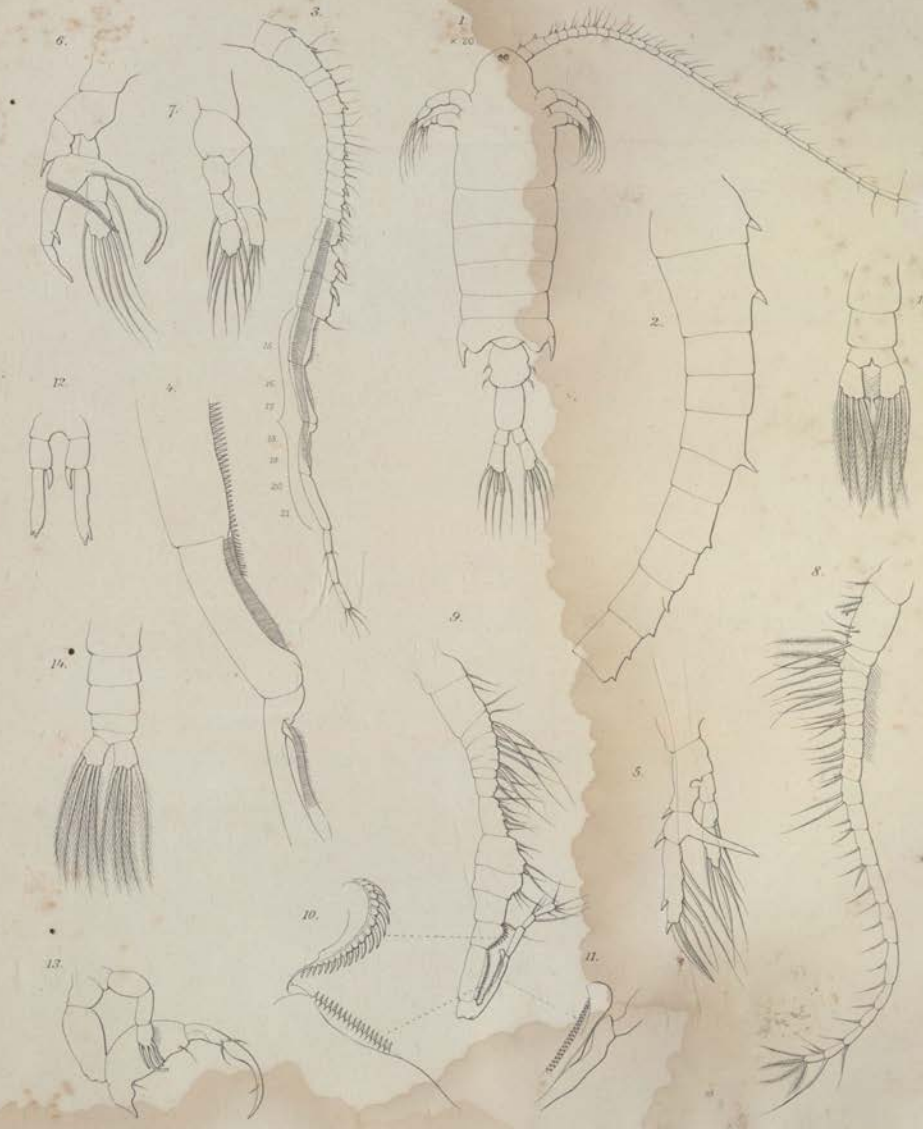
Figs. 10, 11. Denticulated plates of the same, more highly magnified.

Fig. 12. Fifth pair of feet of female.

Fig. 13. Fifth pair of feet of male.

Fig. 14. Abdomen of male.

Fig. 15. Abdomen of female.



G. S. Brady, del. F. Huth, Lith. Edin.

1-7 CENTROPAGES BRACHIATUS, Dana. 8-15 PONTELLA DETRUNCATA, Dana.

PLATE XXVII.

PLATE XXVII.

Centropages violaceus (Claus).

Fig. 1. Male, seen from above, magnified 40 diameters.

Fig. 2. Right anterior antenna of male.

Fig. 3. Hinge-joints of the same, more highly magnified.

Fig. 4. Anterior antenna of female.

Fig. 5. Mandible and palp.

Fig. 6. Maxilla.

Fig. 7. Anterior foot-jaw.

Fig. 8. Posterior foot-jaw.

Fig. 9. Foot of first pair.

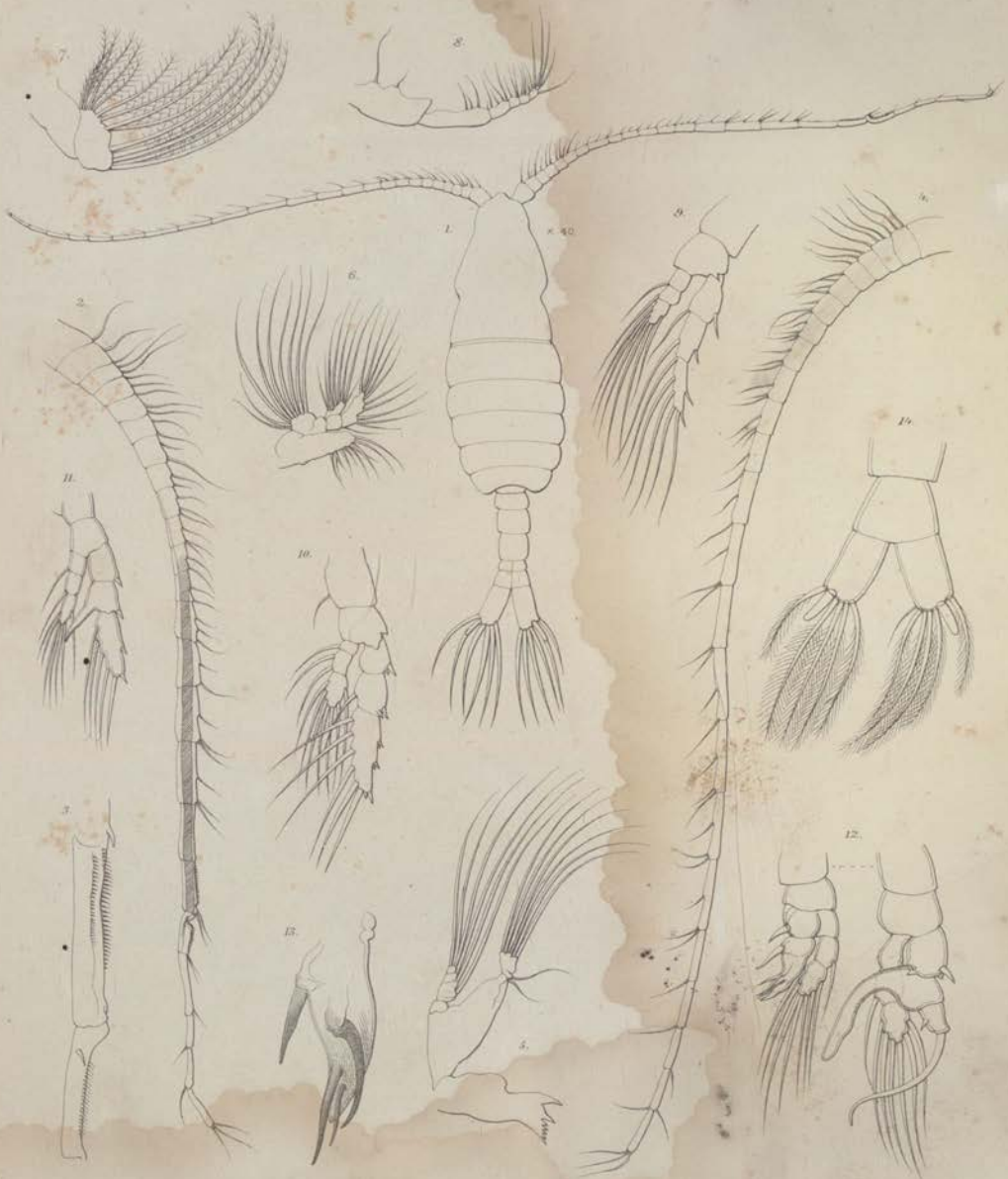
Fig. 10. Foot of fourth pair.

Fig. 11. Foot of fifth pair of female.

Fig. 12. Fifth pair of feet of male.

Fig. 13. Extremity of outer branch of left fifth foot of male, more highly magnified.

Fig. 14. Last joints of abdomen and tail.



G.S. Brady del.

CENTROPAGES VIOLACEUS, Claus.

PLATE XXVIII.

PLATE XXVIII.

Figs. 1–11. *Centropages furcatus* (Dana).

Fig. 1. Female, seen from right side, magnified 80 diameters.

Fig. 2. Cephalothorax of female, seen from above, magnified 50 diameters

Fig. 3. Right anterior antenna of male.

Fig. 4. Serrated plates of the same, more highly magnified.

Fig. 5. Foot of first pair.

Fig. 6. Foot of second pair.

Fig. 7. Foot of third pair.

Fig. 8. Fifth pair of feet of male.

Fig. 9. Foot of fifth pair, female.

Fig. 10. Terminal spines of one of the swimming feet.

Fig. 11. Abdomen of male.

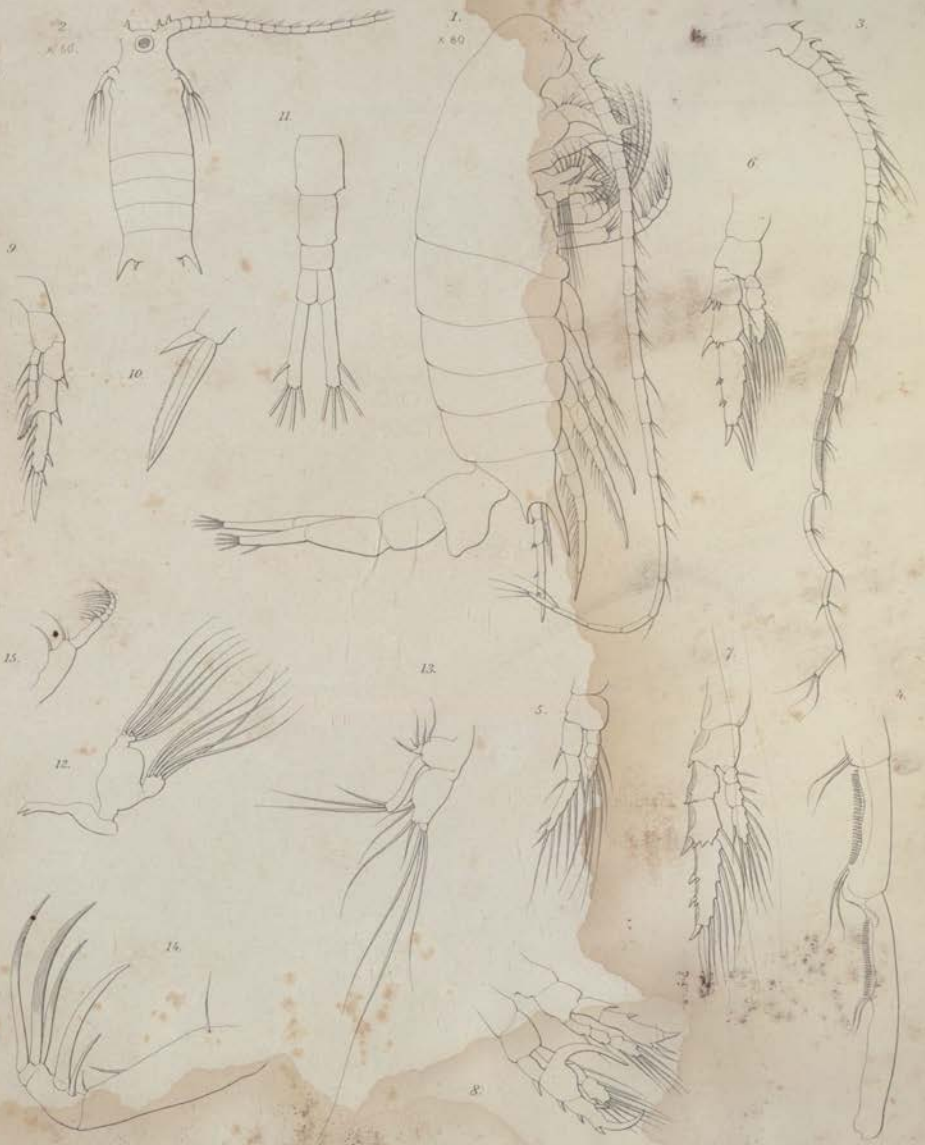
Figs. 12–15. *Candace truncata*, Dana.

Fig. 12. Mandible and palp.

Fig. 13. Maxilla.

Fig. 14. Anterior foot-jaw.

Fig. 15. Posterior foot-jaw.



G. S. Brady, del. F. Huth, Lith. Edin.

1-11 CENTROPAGES FURCATUS, Dana. 12-15 CANDACE TRUNCATA, Dana.

PLATE XXIX.

PLATE XXIX.

Candace truncata, Dana.

Fig. 1. Male, seen from above, magnified 40 diameters.

Fig. 2. Right anterior antenna of male.

Fig. 3. Anterior antenna of female.

Fig. 4. Basal joints of the same, more highly magnified.

Fig. 5. Posterior antenna.

Fig. 6. Foot of first pair.

Fig. 7. Foot of third pair, female.

Fig. 8. Outer branch of third foot, male.

Fig. 9. Fifth pair of feet of male.

Fig. 10. Fifth pair of feet of female.

Fig. 11. Fifth pair of feet of female (var. *bispinosa*).

Fig. 12. Apex of the same, more highly magnified.

Fig. 13. Abdomen of female.

Fig. 14. The same (variety, or young ?).

G.S. Brady, del. F. Huth, Lith. Edin.

CANDACE TRUNCATA, Dana.

PLATE XXX.

PLATE XXX.

Candace pectinata, Brady.

Fig. 1. Female, seen from above.

Fig. 2. Female, seen from right side, both magnified 32 diameters.

Fig. 3. Anterior antenna of female.

Fig. 4. Right anterior antenna of male.

Fig. 5. Basal joints of the same.

Fig. 6. Pectinated joints of the same.

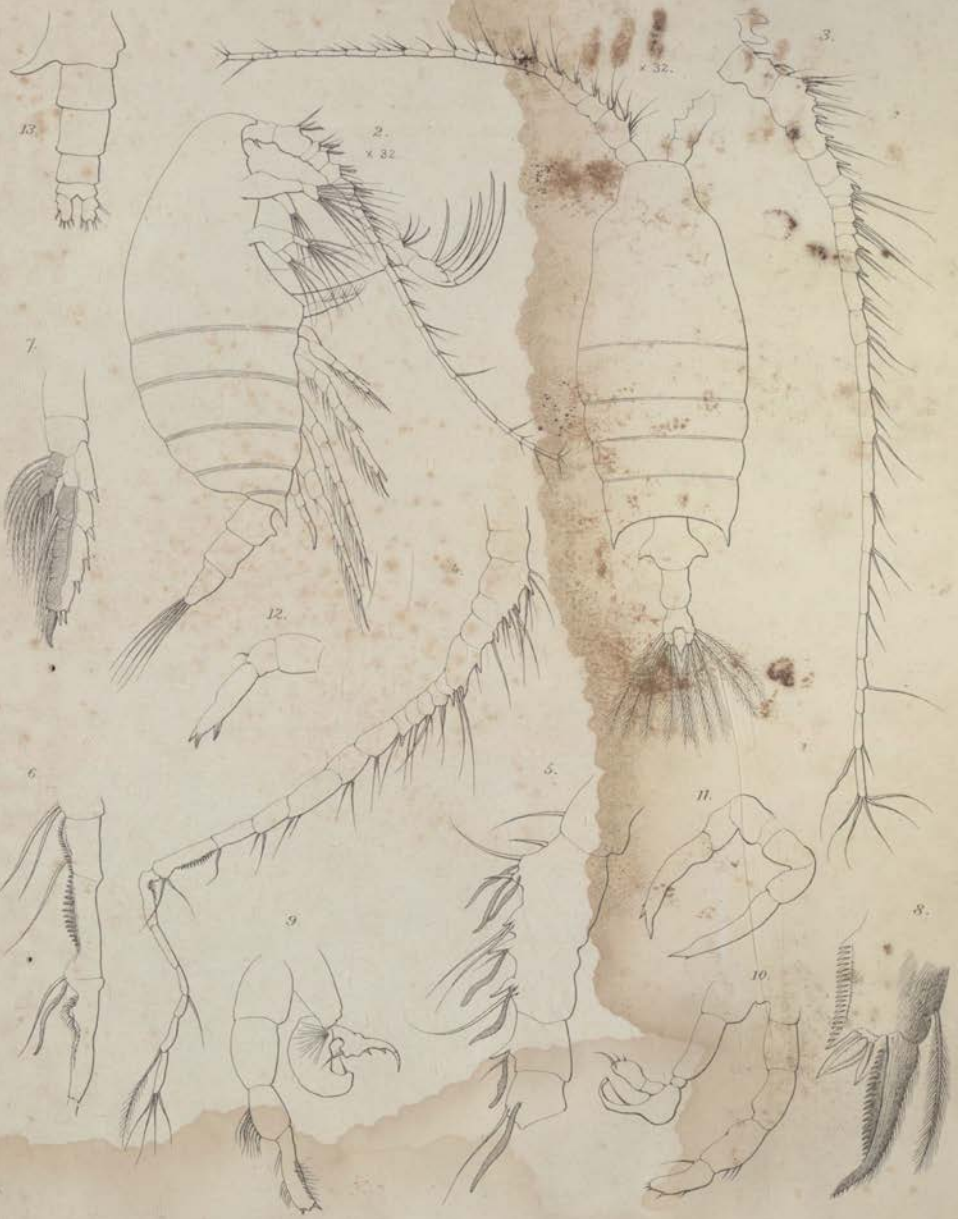
Fig. 7. One of the swimming feet.

Fig. 8. End of outer branch of third foot.

Figs. 9, 10. Fifth pair of feet of male, two different specimens.

Figs. 11, 12. Fifth pair of feet of female, two different specimens.

Fig. 13. Abdomen of male.



G. S. Brady del. F. Roth, Lith. Edin.

CANDACE PECTINATA, Brady.

PLATE XXXI.

PLATE XXXI.

Fig. 1. *Acartia denticornis*, n. sp.

Fig. 1. Female, seen from above, magnified 80 diameters.

Figs. 2–9. *Candace pachydactyla*, Dana.

Fig. 2. Anterior antenna of female.

Fig. 3. Anterior antenna of male.

Fig. 4. Pectinated joints of the same, more highly magnified.

Fig. 5. Outer branch of one of the swimming feet.

Fig. 6. Fifth pair of feet of male.

Fig. 7. The same, from an immature specimen.

Fig. 8. Fifth pair of feet of female.

Fig. 9. Abdomen of male.

Figs. 10–12. *Corynura barbata*, n. gen. and sp.

Fig. 10. Anterior antenna of female.

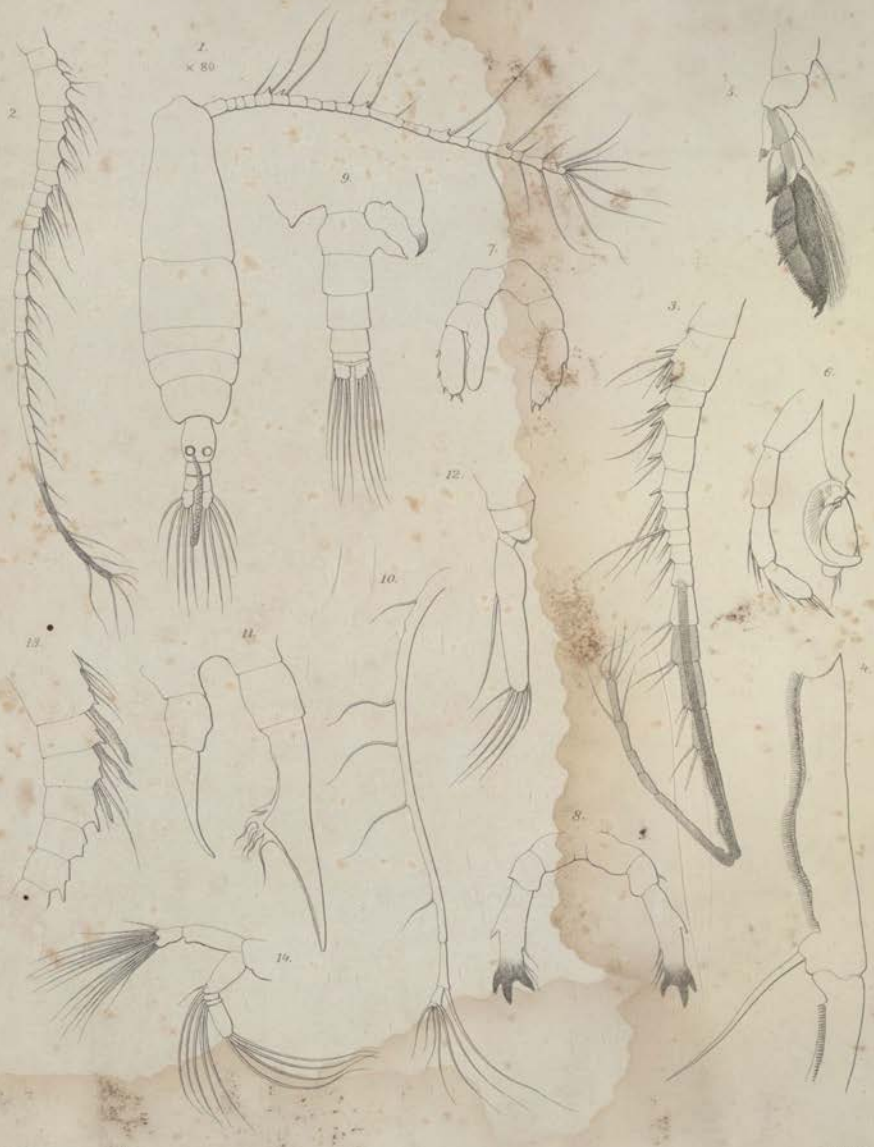
Fig. 11. Fifth pair of feet.

Fig. 12. One of the caudal stylets (with last abdominal rings).

Figs. 13, 14. *Pleuromma abdominale* (Lubbock).

Fig. 13. Base of anterior antenna of female.

Fig. 14. Posterior antenna.



G. S. Brady del.

J. Buck, Lith. Edinr.

1 ACARTIA DENTICORNIS, n. sp. 2-9 CANDACE PACHYDACTYLA, Dana.
10-12 CORYNURA BARBATA, n. gen. & sp. 13, 14 PLEUROMMA ABDOMINALE, Lubbock.

PLATE XXXII.

PLATE XXXII.

Figs. 1–11. *Acartia laxa*, Dana.

Fig. 1. Female, magnified 40 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Posterior antenna.

Fig. 4. Mandible and palp.

Fig. 5. Maxilla.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw.

Fig. 8. Foot of first pair.

Fig. 9. Outer branch of one of the swimming feet.

Fig. 10. Fifth pair of feet of female.

Fig. 11 Abdomen of female.

Figs. 12–17. *Acartia denticornis*, n. sp.

Fig. 12. Anterior antenna of male.

Fig. 13. Posterior foot-jaw.

Fig. 14. Foot of third pair.

Fig. 15. Fifth foot of male (one side only.)

Fig. 16. Fifth pair of feet of female.

Fig. 17. Abdomen of male.

G. S. Brady, del.

F. Huth, Lith. Edin.

1-11 ACARTIA LAXA, Dana. 12-17 ACARTIA DENTICORNIS, n. sp.

PLATE XXXIII.

PLATE XXXIII.

Corynura gracilis, n. gen. and sp.

Fig. 1. Male, seen from below.

Fig. 2. Female, seen from right side; both magnified 50 diameters.

Fig. 3. Anterior antenna of female.

Fig. 4. Denticulated portion of right male antenna.

Fig. 5. Posterior antenna.

Fig. 6. Mandible and palp.

Fig. 7. Maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

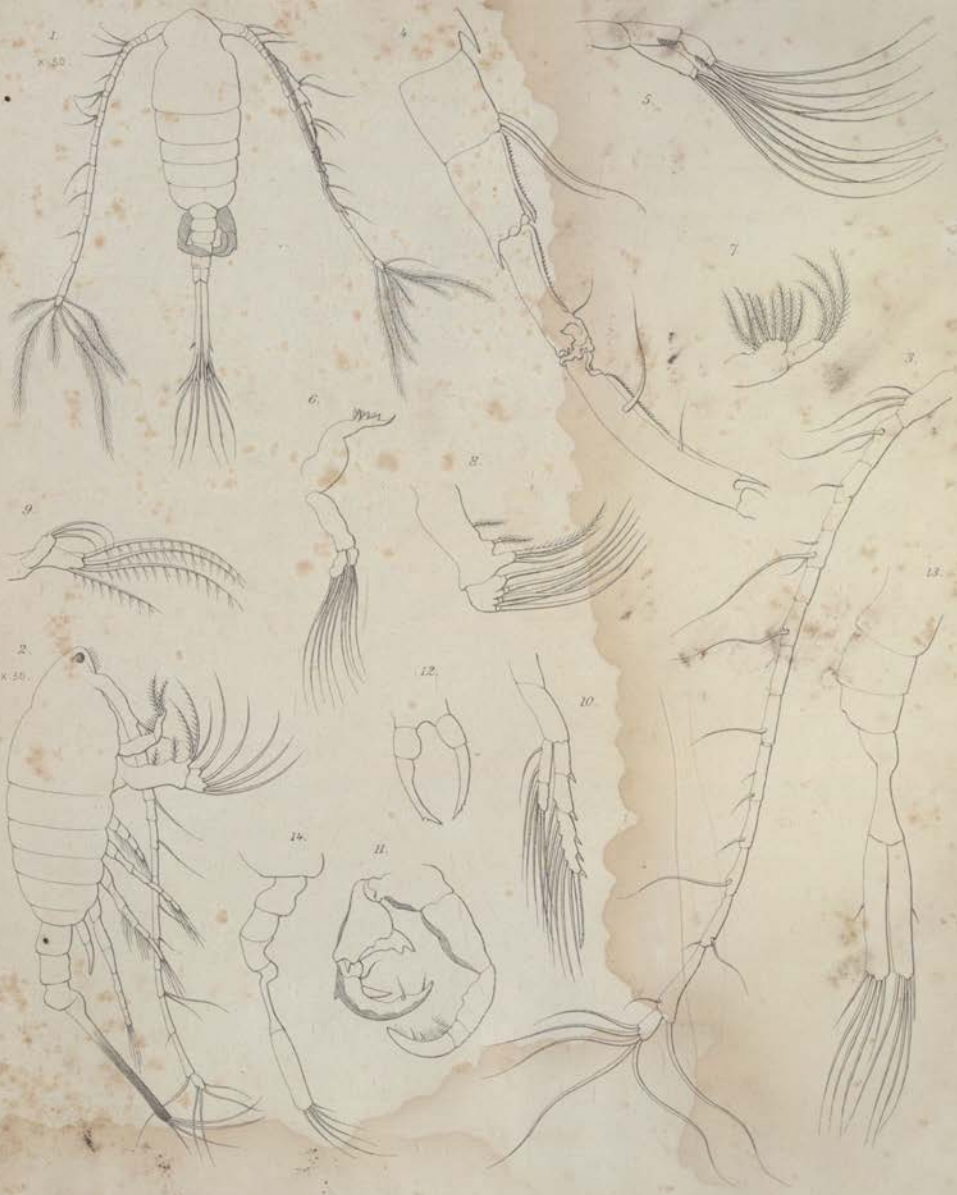
Fig. 10. One of the swimming feet.

Fig. 11. Fifth pair of feet of male.

Fig. 12. Fifth pair of feet of female.

Fig. 13. Abdomen and tail of female, seen from front.

Fig. 14. The same seen laterally.



CORYNURA GRACILIS, n. gen. & sp.

PLATE XXXIV.

PLATE XXXIV.

Figs. 1–9. *Calanopia elliptica*, Dana.

Fig. 1. Female, magnified 50 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Right anterior antenna of male, with rostrum and eyes.

Fig. 4. Denticulated joint of same, more highly magnified.

Fig. 5. Mandible and palp.

Fig. 6. Fifth pair of feet of female.

Fig. 7. Fifth pair of feet of male.

Fig. 8. Extremity of left fifth foot of male, more highly magnified.

Fig. 9. Abdomen and tail of male.

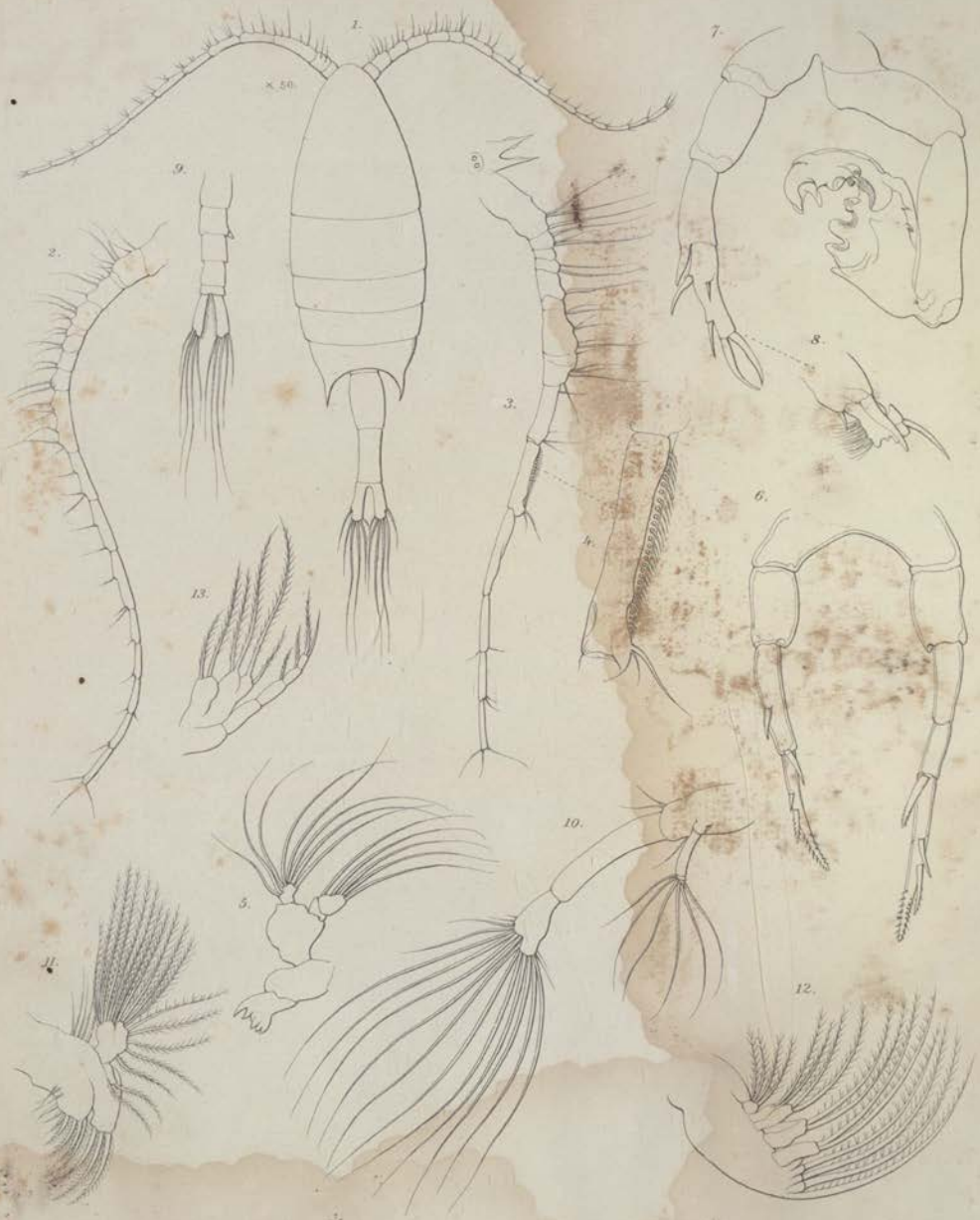
Figs. 10–13. *Pontellopsis villosa*, n. gen. and sp.

Fig. 10. Posterior antenna.

Fig. 11. Maxilla.

Fig. 12. Anterior foot-jaw.

Fig. 13. Posterior foot-jaw.



G. S. Brady, del.

F. Huth, Lith.

1-9 CALANOPIA ELLIPTICA, Dana. 10-13 PONTELLOPSIS VILLOSA, n. gen. & sp.

PLATE XXXV.

PLATE XXXV.

Figs. 1–13. *Pontella acutifrons* (Dana).

Fig. 1. Male, seen from above, magnified 16 diameters.

Fig. 2. Forehead and rostrum with superior eyes.

Fig. 3. Left anterior antenna of male.

Fig. 4. Right anterior antenna of male.

Fig. 5. Denticulated joints of the same, more highly magnified.

Figs. 6, 7. Teeth of the upper and lower denticulated plates.

Fig. 8. Outer branch of one of the swimming feet.

Fig. 9. Fifth pair of feet of female.

Fig. 10. Fifth pair of feet of male.

Fig. 11. Appendage of the same, more highly magnified.

Fig. 12. Abdomen of female.

Fig. 13. Abdomen of male.

Figs. 14–20. *Pontellopsis villosa*, n. gen. and sp.

Fig. 14. Female, seen from above, magnified 20 diameters.

Fig. 15. Anterior antenna of same.

Fig. 16. Mandible and palp.

Fig. 17. Foot of first pair.

Fig. 18. Foot of second pair.

Fig. 19. Fifth pair of feet of female.

Fig. 20. Abdomen of female.

1-13 PONTELLA ACUTIFRONS, Dana. 14-20 PONTELLOPSIS VILLOSA, n. gen. & sp.

PLATE XXXVI.

PLATE XXXVI.

Pontella acuta (Dana).

Fig. 1. Female, seen from right side; magnified 32 diameters.

Fig. 2. Anterior antenna of left side (male).

Fig. 3. Anterior antenna of right side (male).

Figs. 4, 5. Portions of denticulated plates of same, more highly magnified.

Fig. 6. Maxilla.

Fig. 7. Posterior foot-jaw.

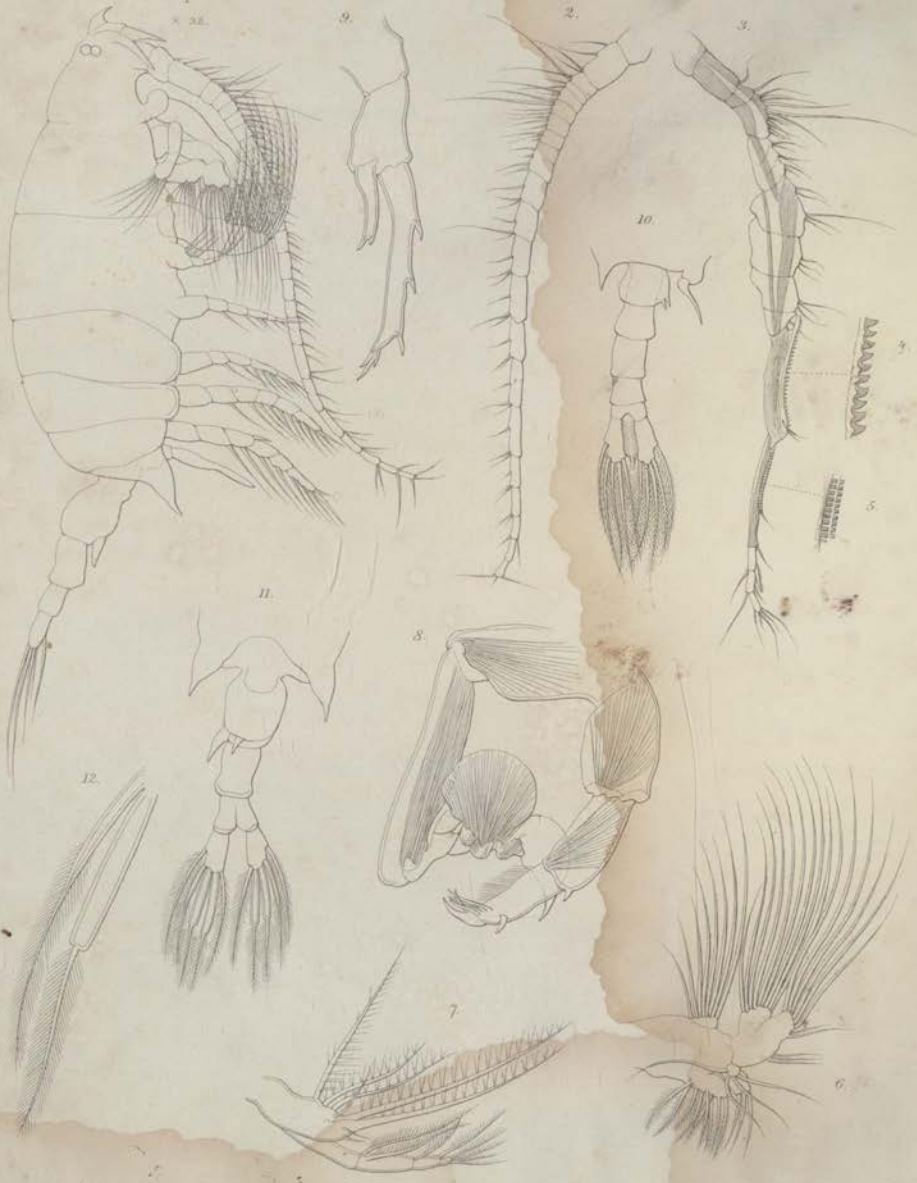
Fig. 8. Fifth pair of feet of male.

Fig. 9. Fifth pair of feet of female.

Fig. 10. Abdomen and posterior thoracic angles of male.

Fig. 11. The same structures of female.

Fig. 12. Second and third tail setæ of female, more highly magnified.



G.S. Brady, del.

F. Huth, Lith^r Edin^r

PONTELLA ACUTA, Dana.

PLATE XXXVII.

PLATE XXXVII.

Pontella plumata (Dana).

Fig. 1. Female, seen from left side; magnified 40 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Right anterior antenna of male.

Fig. 4. Posterior antenna of female.

Fig. 5. Mandible of female.

Fig. 6. Foot of first pair.

Fig. 7. Foot of third pair.

Fig. 8. Fifth pair of feet of female.

Fig. 9. Fifth pair of feet of male.

Fig. 10. Abdomen of female.

Fig. 11. Abdomen of male.

J. S. Brady del. F. Huth, Lith. Edin.

PONTELLA PLUMATA, Dana.

PLATE XXXVIII.

PLATE XXXVIII.

Figs. 1–6. *Pontella lævidentata*, n. sp.

Fig. 1. Male, seen from above; magnified 50 diameters.

Fig. 2. Right anterior antenna of the same.

Fig. 3. Serrated plates of the same, more highly magnified.

Fig. 4. One of the swimming feet.

Fig. 5. Fifth pair of feet of male.

Fig. 6. End of left foot of the same, more highly magnified.

Figs. 7–14. *Pontella elephas*, n. sp.

Fig. 7. Male, seen from above; magnified 30 diameters.

Fig. 8. Anterior antenna of female.

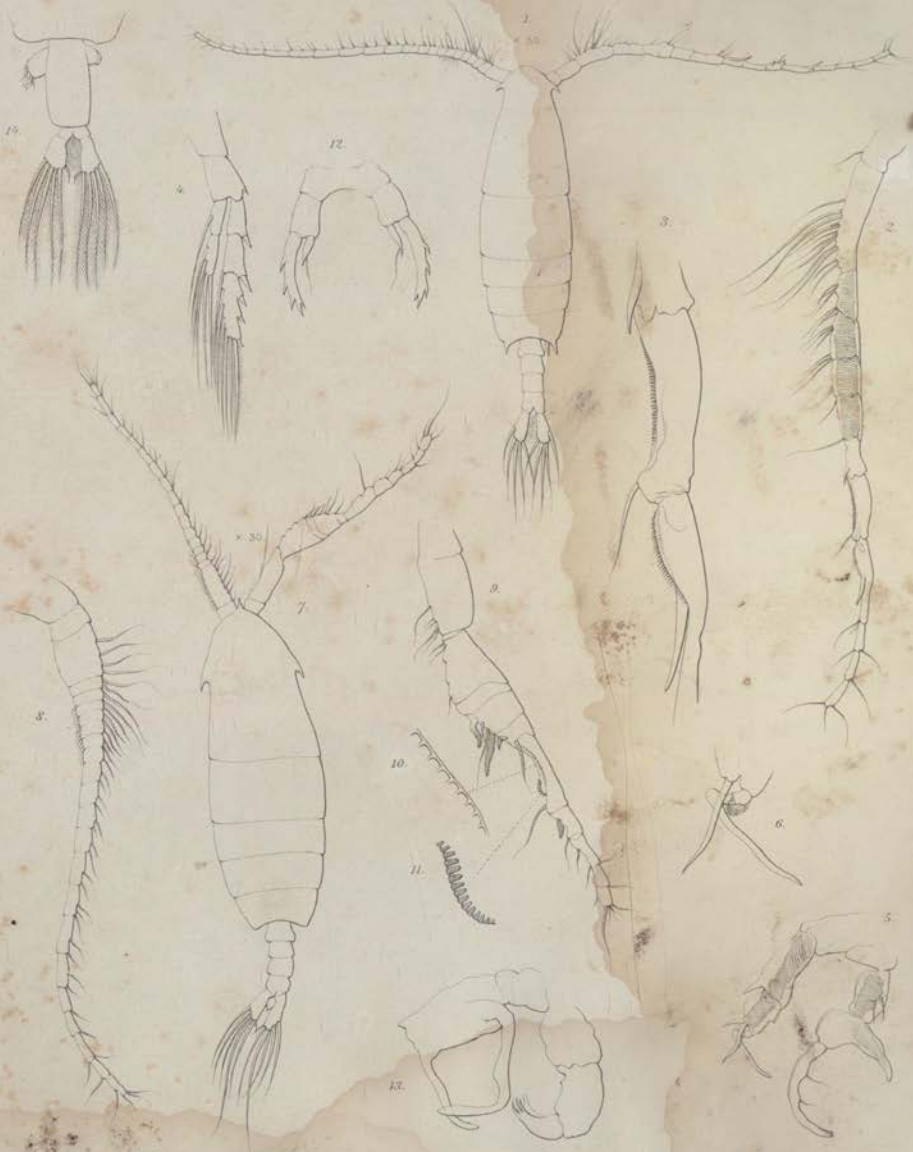
Fig. 9. Right anterior antenna of male.

Figs. 10, 11. Teeth of denticulated plate of the same, more highly magnified.

Fig. 12. Fifth pair of feet of female.

Fig. 13. Fifth pair of feet of male.

Fig. 14. Abdomen of female.



G. S. Brady del.

F. Huth, Lith. Edin.

1-6 PONTELLA LÆVIDENTATA, n. sp. 7-14 PONTELLA ELEPHAS, n. sp.

PLATE XXXIX.

PLATE XXXIX.

Pontella kröyeri, n. sp.

Fig. 1. Female, seen from above; magnified 40 diameters.

Fig. 2. Anterior antenna of female.

Fig. 3. Right anterior antenna of male.

Fig. 4. Portion of teeth of the same, more highly magnified.

Fig. 5. Posterior antenna.

Fig. 6. Mandible and palp.

Fig. 7. Maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. Fifth pair of feet of female.

Fig. 11. Fifth pair of feet of male.

Fig. 12. Terminal papillæ, &c., of fifth foot of left side.

Fig. 13. The same of another specimen.

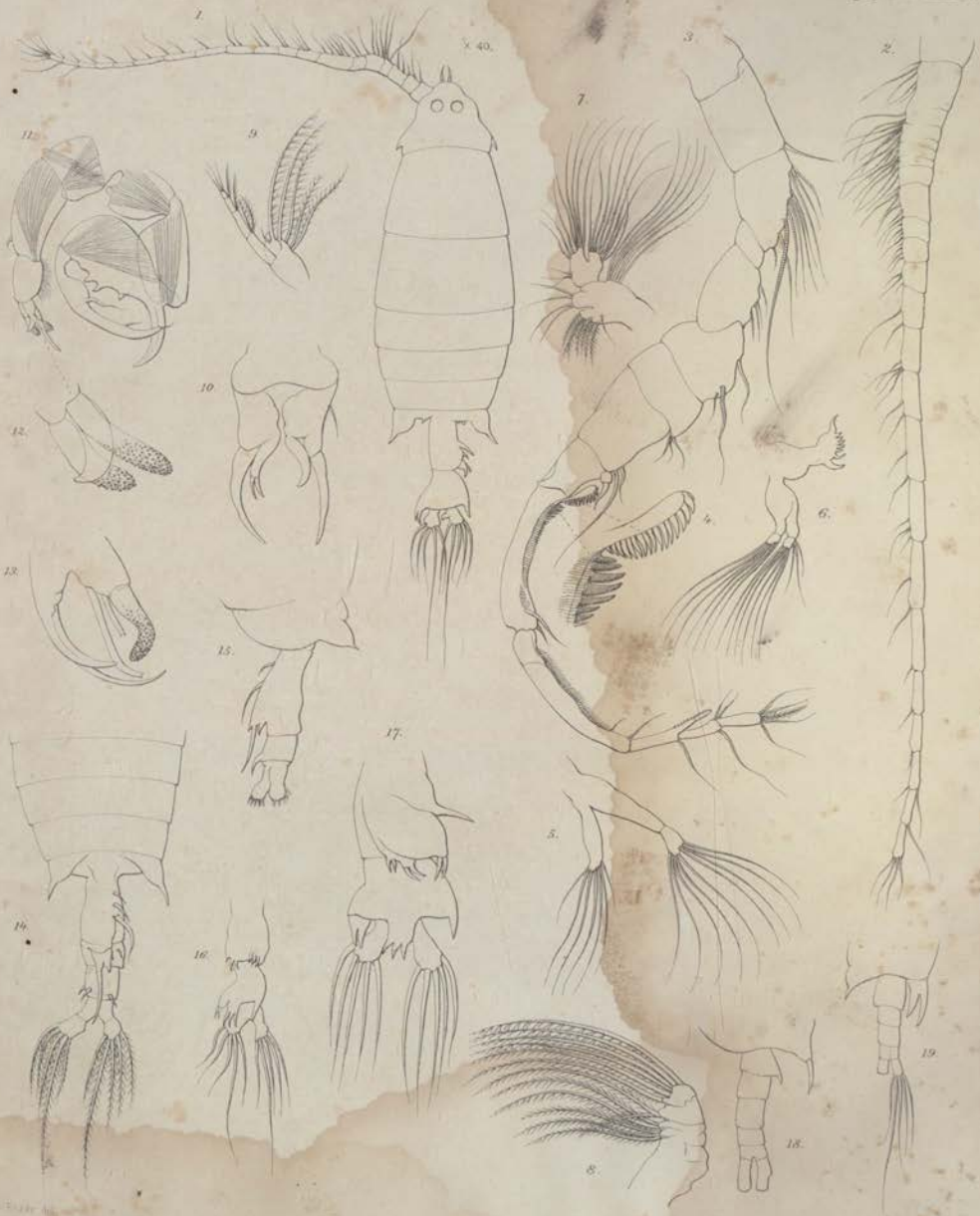
Fig. 14. Posterior thoracic segments and abdomen of female (ventral aspect).

Fig. 15. The same (lateral aspect).

Figs. 16, 17. Female abdomen—other specimens.

Fig. 18. Male abdomen, seen laterally.

Fig. 19. The same, seen from front.



PONTELLA KROYERI, n. sp.

PLATE XL.

PLATE XL.

Figs. 1–10. *Oithona challengerii*, n. sp.

Fig. 1. Female, seen from above; magnified 50 diameters.

Fig. 2. Rostrum.

Fig. 3. Posterior antenna.

Fig. 4. Maxilla.

Fig. 5. Anterior foot-jaw.

Fig. 6. Posterior foot-jaw.

Fig. 7. Foot of first pair.

Fig. 8. Foot of fourth pair.

Figs. 9, 10. Basal portions of the two setæ of fifth foot.

Figs. 11–15. *Zaus spinatus*, Goodsir.

Fig. 11. Anterior antenna.

Fig. 12. Mandible and palp.

Fig. 13. Foot of first pair.

Fig. 14. One of the swimming feet.

Fig. 15. Foot of fifth pair.

1-10 OITHONA CHALLENGERII, n. sp. 11-15 ZAUS SPINATUS, Goodsir.

PLATE XLI.

PLATE XLI.

Figs. 1–12. *Machairopus idyoides*, n. gen. and sp.

Fig. 1. Female, seen from above.

Fig. 2. Male seen from side; both magnified 50 diameters.

Fig. 3. Anterior antenna of female.

Fig. 4. Posterior antenna.

Fig. 5. Mandible and palp.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw.

Fig. 8. Foot of first pair.

Fig. 9. One of the following pairs of swimming feet.

Fig. 10. Foot of fifth pair, female.

Fig. 11. Abdomen of female.

Fig. 12. Abdomen of male.

Figs. 13–17. *Zaus spinatus*, Goodsir.

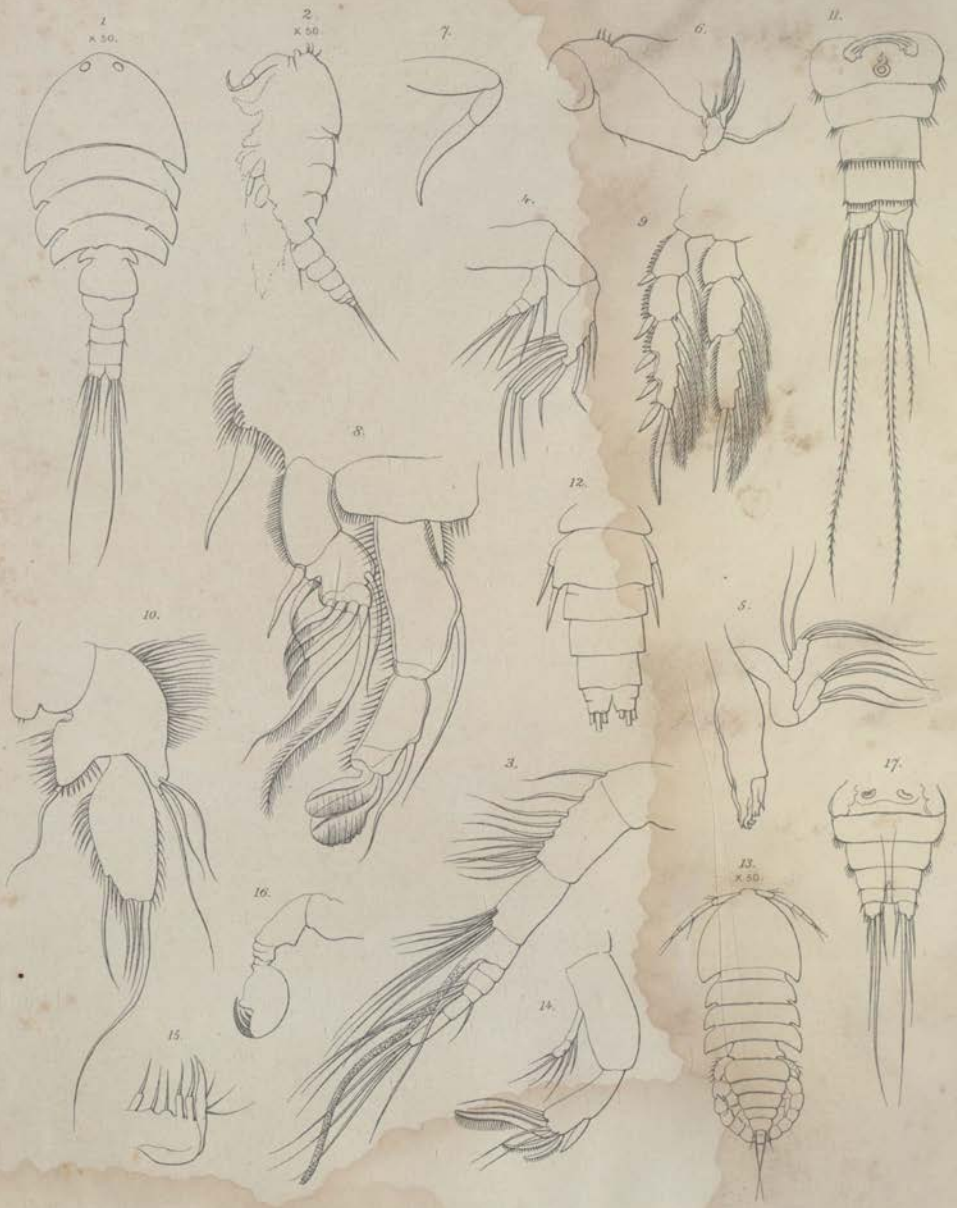
Fig. 13. Female, magnified 50 diameters.

Fig. 14. Posterior antenna.

Fig. 15. Anterior foot-jaw.

Fig. 16. Posterior foot-jaw.

Fig. 17. Abdomen and tail.



1-12 MACHAIROPUS IDYOIDES, n. gen. & sp. 13-17 ZAUS SPINATUS, Goodsir.

PLATE XLII.

PLATE XLII.

Figs. 1–8. *Pseudothalestris imbricata*, n. gen. and sp.

Fig. 1. Anterior antenna of male.

Fig. 2. Inner branch of posterior antenna.

Fig. 3. Posterior foot-jaw.

Fig. 4. Foot of first pair.

Fig. 5. Foot of second pair.

Fig. 6. Foot of third and fourth pairs.

Fig. 7. Foot of fifth pair.

Fig. 8. Abdomen and tail.

Figs. 9–16. *Goniopsyllus rostratus*, n. gen. and sp.

Fig. 9. Male, seen from the left side.

Fig. 10. The same, seen from above; both magnified 80 diameters.

Fig. 11. Anterior antenna.

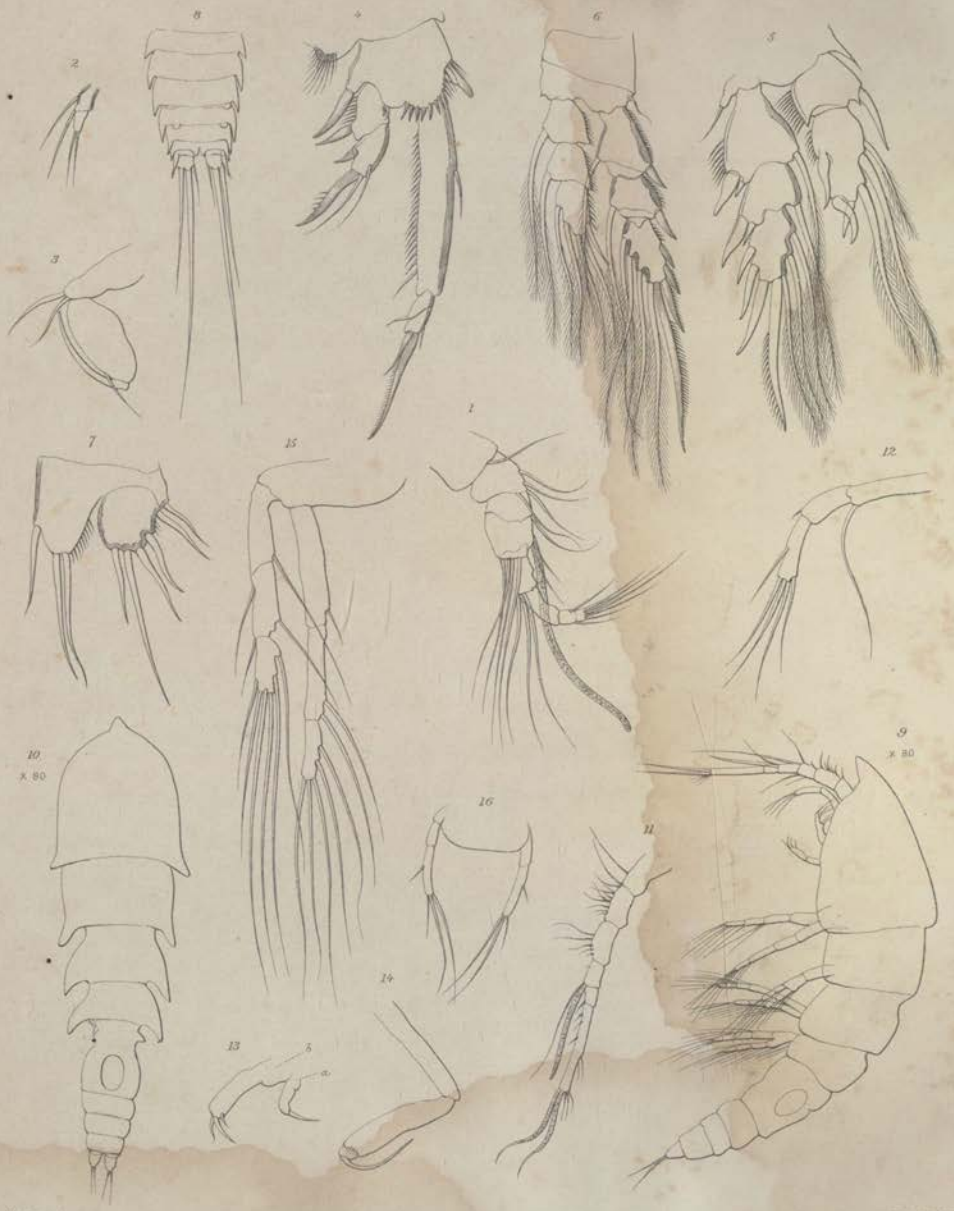
Fig. 12. Posterior antenna.

Fig. 13. *a*, Maxilla; *b*, anterior foot-jaw.

Fig. 14. Posterior foot-jaw.

Fig. 15. One of the swimming feet.

Fig. 16. Fifth pair of feet.



G. S. Brady del.

F. Huth, Lith. Edin.

1-8 PSEUDOTHALESTRIS IMBRICATA, n. gen. & sp. 9-16 GONIOPSYLLUS ROSTRATUS, n. gen. & sp.

PLATE XLIII.

PLATE XLIII.

Figs. 1–16. *Miracia efferata*, Dana.

Fig. 1. Male, seen from right side; magnified 55 diameters.

Fig. 2. Female, seen from left side; magnified 50 diameters.

Fig. 3. Anterior antenna of male.

Fig. 4. Anterior antenna of female.

Fig. 5. Posterior antenna.

Fig. 6. Mandible.

Fig. 7. Maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. Foot of first pair.

Fig. 11. Inner branch of second foot of male.

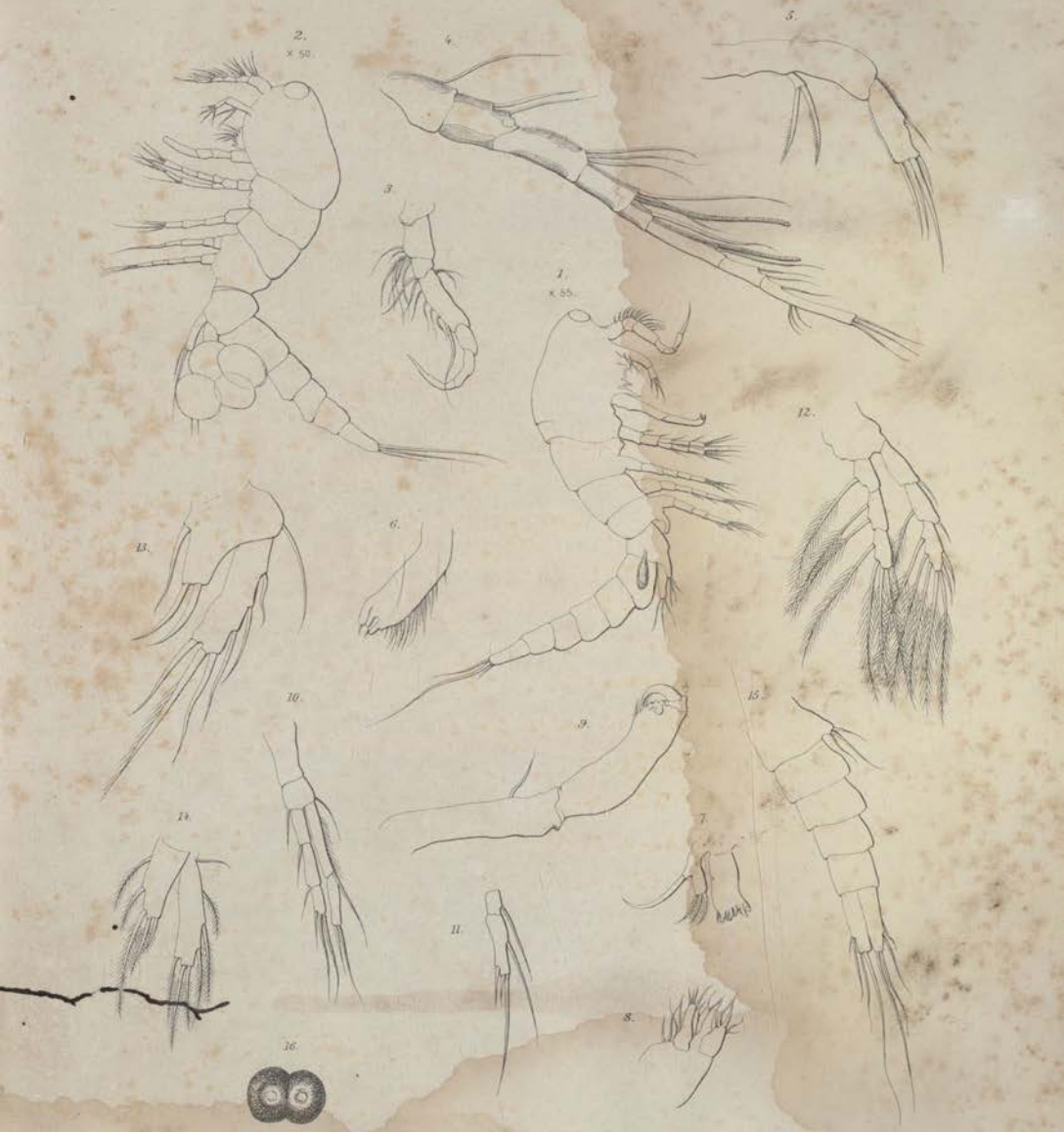
Fig. 12. Foot of third and fourth pairs.

Fig. 13. Fifth foot, male.

Fig. 14. Fifth foot, female.

Fig. 15. Abdomen of male.

Fig. 16. Corneal lenses.



S. S. Brady, del. F. Huth, Lith. Edin.

MIRACIA EFFERATA, Dana

PLATE XLIV.

PLATE XLIV.

Pontostratiotes abyssicola, n. gen. and sp.

Fig. 1. Animal, seen from above.

Fig. 2. The same, seen from left side; both magnified 40 diameters.

Fig. 3. Spines of cephalothorax.

Fig. 4. Anterior antenna.

Fig. 5. Posterior antenna.

Fig. 6. Mandible and palp.

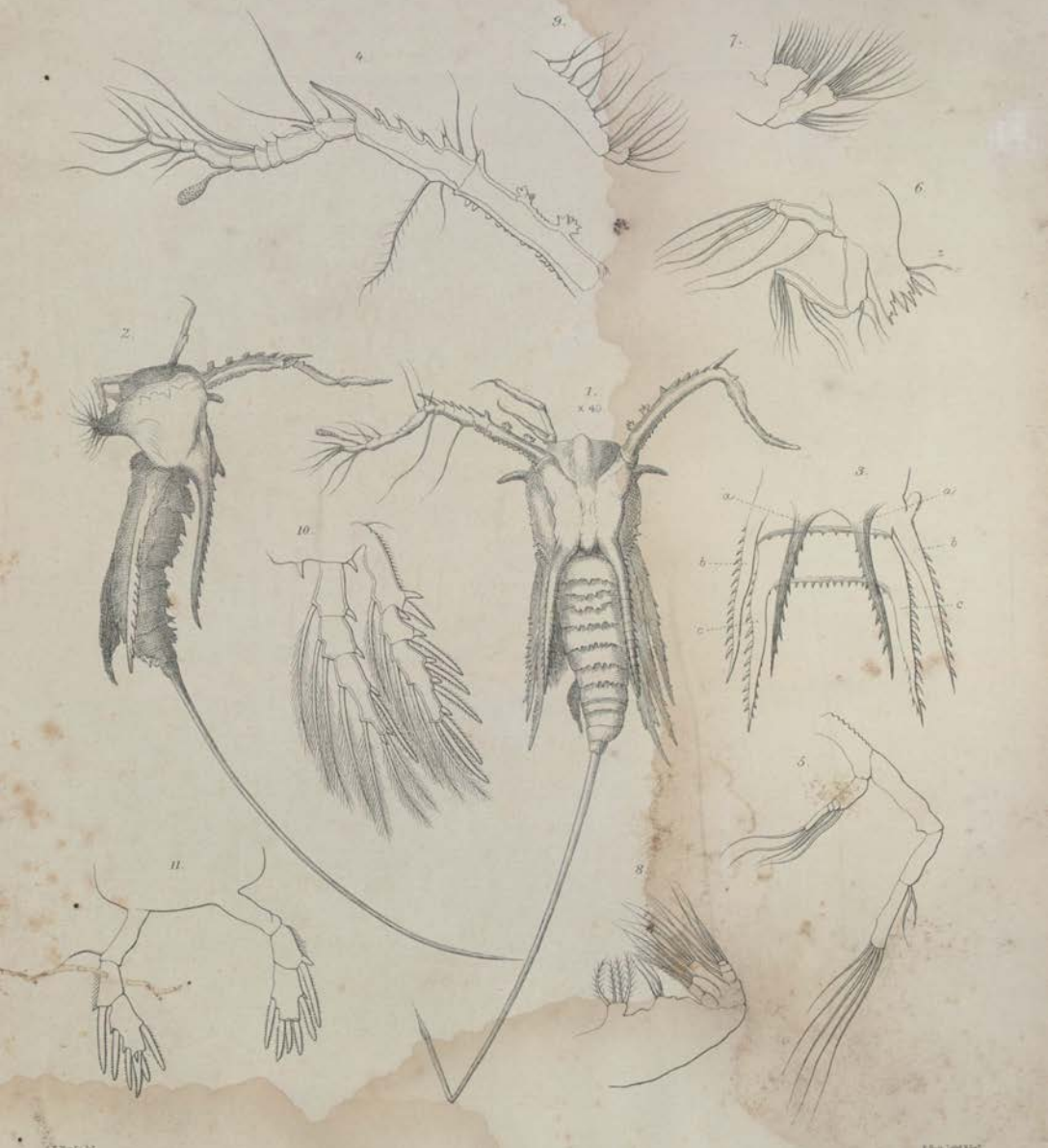
Fig. 7. Maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. One of the swimming feet.

Fig. 11. Fifth pair of feet.



PONTOSTRATIOTES ABYSSICOLA, n. gen. & sp.

PLATE XLV.

PLATE XLV.

Figs. 1–9. *Pontella securifer*, n. sp.

Fig. 1. Right anterior antenna of male.

Fig. 2. Side view of rostrum with eyes (slightly oblique).

Fig. 3. The same, seen from above.

Fig. 4. Mandible and palp.

Fig. 5. Fifth pair of feet of male.

Fig. 6. Fifth pair of feet of female.

Fig. 7. Abdomen of male.

Fig. 8. Abdomen of female (without tail setæ), seen from left side.

Fig. 9. The same, seen from behind.

Figs. 10–15. *Pontella inermis*, n. sp.

Fig. 10. Male (?), seen from above; magnified 16 diameters.

Fig. 11. Right anterior antenna of the same.

Fig. 12. Left anterior antenna of the same.

Fig. 13. Apex of mandible.

Fig. 14. Terminal and lateral spines of swimming foot.

Fig. 15. Fifth pair of feet of male ?

Figs. 16–19. *Pontella strenua*, Dana.

Fig. 16. Anterior antenna of male (imperfect).

Fig. 17. Fifth pair of feet of male and extremity of that of left side, more highly magnified.

Figs. 18, 19. Abdomen of two different specimens.

Fig. 20. *Pontella detruncata*, Dana.

Fig. 20. Fifth pair of feet of female.

G. S. Brady del.

F. Huth, Lith^r Edin^r

1-9 PONTELLA SECURIFER, n. sp. 10-15 P. INERMIS, n. sp.
16-19 P. STRENUA, Dana. 20 P. DETRUNCATA, Dana.

PLATE XLVI.

PLATE XLVI.

Fig. 1. *Calanus gracilis*, Dana.

Fig. 1. Outer branch of the first swimming foot.

Figs. 2–4. *Hemicalanus aculeatus*, n. sp.

Fig. 2. Female (?), seen from above; magnified 16 diameters.

Fig. 3. Maxilla.

Fig. 4. Foot of second pair.

Figs. 5–6. *Corycæus speciosus*, Dana.

Fig. 5. Adult, seen from above.

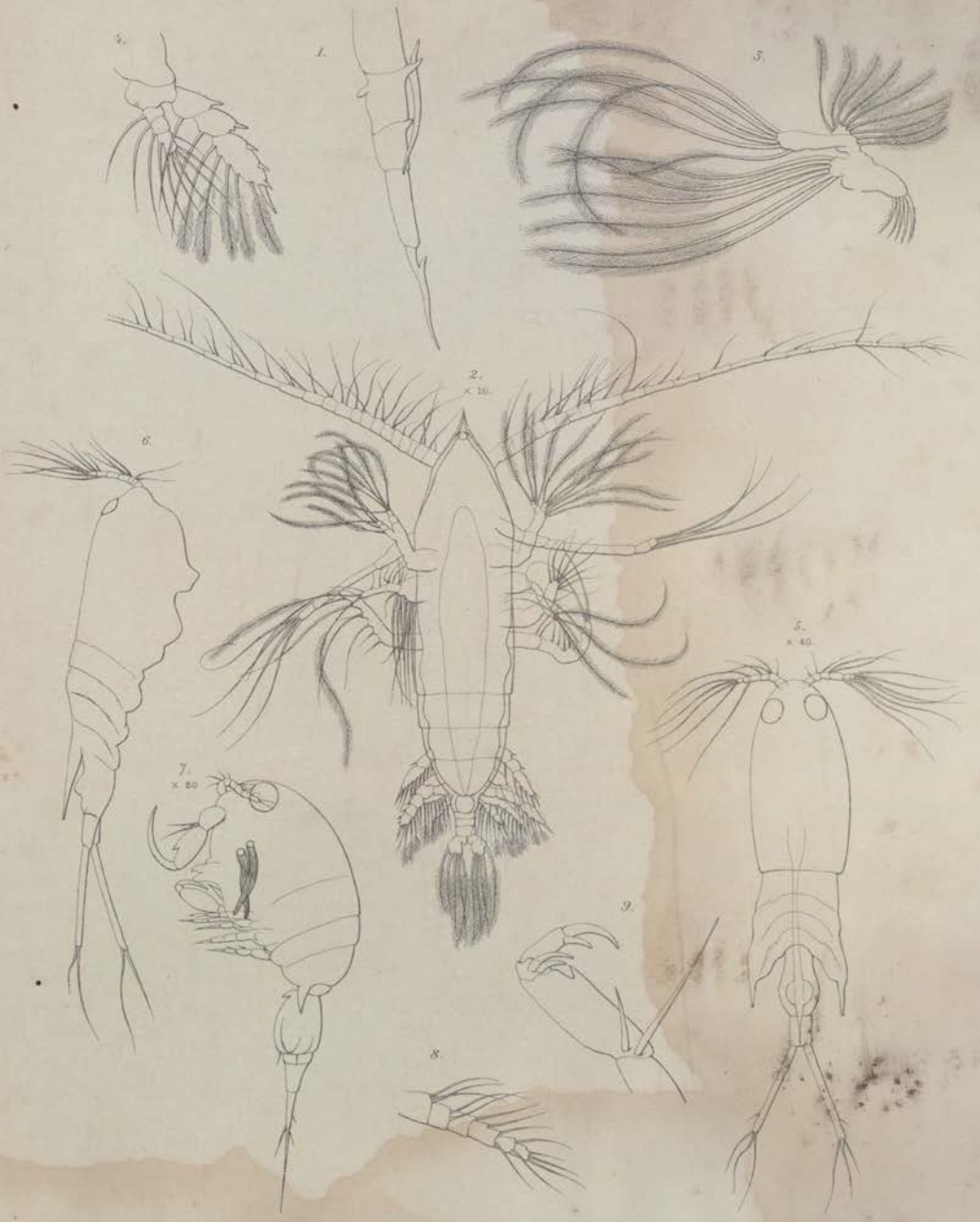
Fig. 6. Adult, seen from right side; both magnified 40 diameters.

Figs. 7–9. *Corycæus obtusus*, Dana.

Fig. 7. Adult, seen from left side; magnified 80 diameters.

Fig. 8. Anterior antenna.

Fig. 9. Posterior antenna.



1 CALANUS GRACILIS, Dana. 2-4 HEMICALANUS ACULEATUS, n. sp.
5,6 CORYCÆUS SPECIOSUS, Dana. 7-9 CORYCÆUS OBTUSUS, Dana.

PLATE XLVII.

PLATE XLVII.

Figs. 1–12. *Saphirina ovalis*, Dana.

Fig. 1. Male, seen from above; magnified 40 diameters.

Fig. 2. Female, seen from above; magnified 40 diameters.

Fig. 3. Anterior antenna of male.

Fig. 4. Anterior antenna of female.

Fig. 5. Posterior antenna of male.

Fig. 6. Posterior antenna of female.

Fig. 7. *a*, Mandible; *b*, maxilla.

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. Foot of fourth pair.

Fig. 11. Foot of fifth pair.

Fig. 12. Last thoracic segment and abdomen of female.

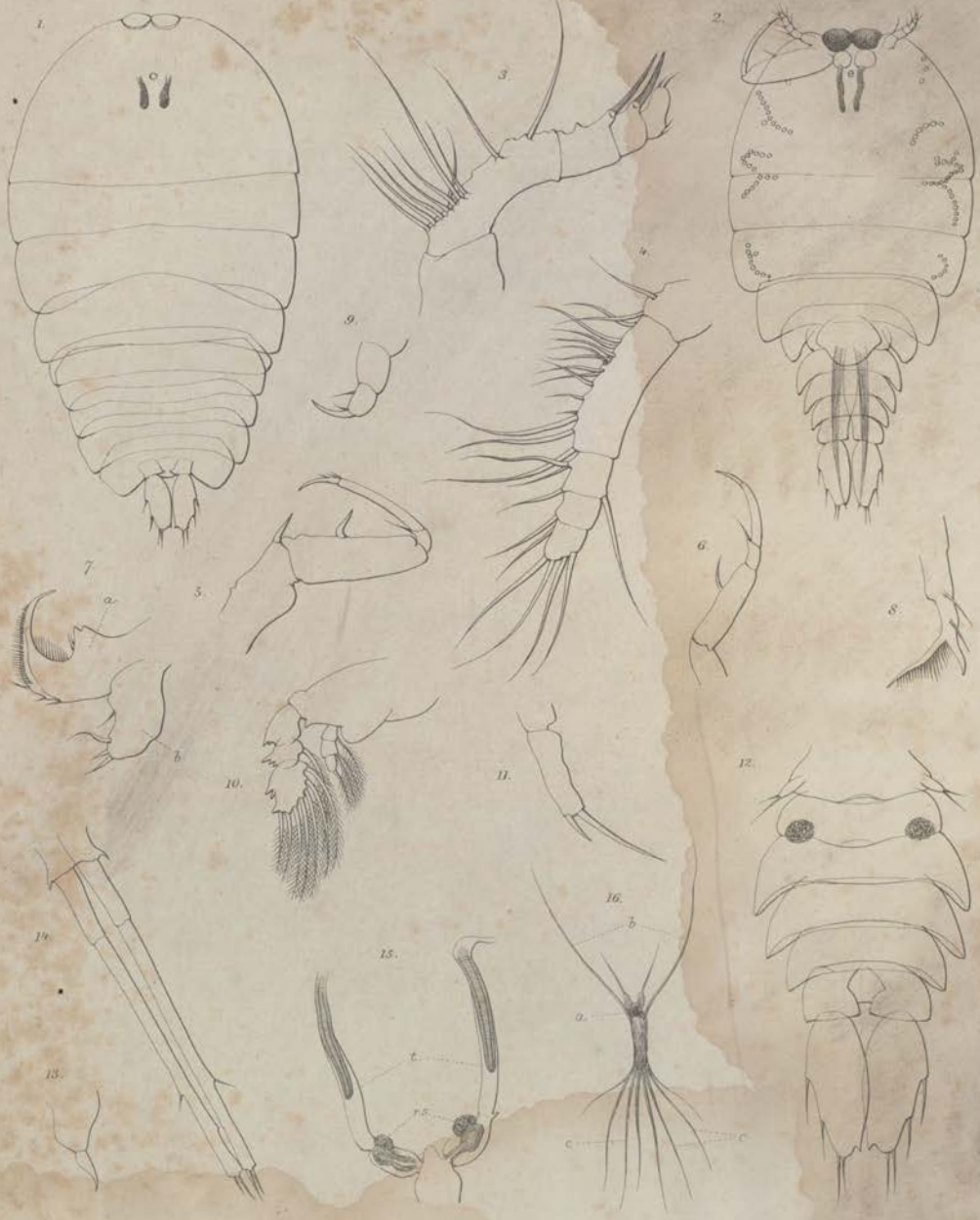
Figs. 13–16. *Saphirinella stylifera* (Lubbock).

Fig. 13. Anterior foot-jaw, seen from side.

Fig. 14. Caudal stylets.

Fig. 15. Male genital organs,—*t*, testis; *r.s.* receptaculum seminis.

Fig. 16. Nervous centres,—*a*, brain; *bb*, antennal nerves; *cc*, pedal nerves.



G.S. Brady del.

F. Huth, Lith^r. Edin^r.

1-12 SAPHIRINA OVALIS; Dana. 13-16 SAPHIRINELLA STYLIFERA, Lubbock.

PLATE XLVIII.

PLATE XLVIII.

Figs. 1–5. *Saphirina inæqualis*, Dana.

Fig. 1. Male, seen from above.

Fig. 2. Female, seen from above; both magnified 40 diameters.

Fig. 3. Anterior antenna.

Fig. 4. Posterior antenna.

Fig. 5. One of the swimming feet.

Figs. 6–8. *Saphirina gemma*, Dana.

Fig. 6. Female, seen from above; magnified 40 diameters.

Fig. 7. Anterior antenna of female.

Fig. 8. Posterior antenna of the same.

Figs. 9–13. *Saphirinella stylifera* (Lubbock).

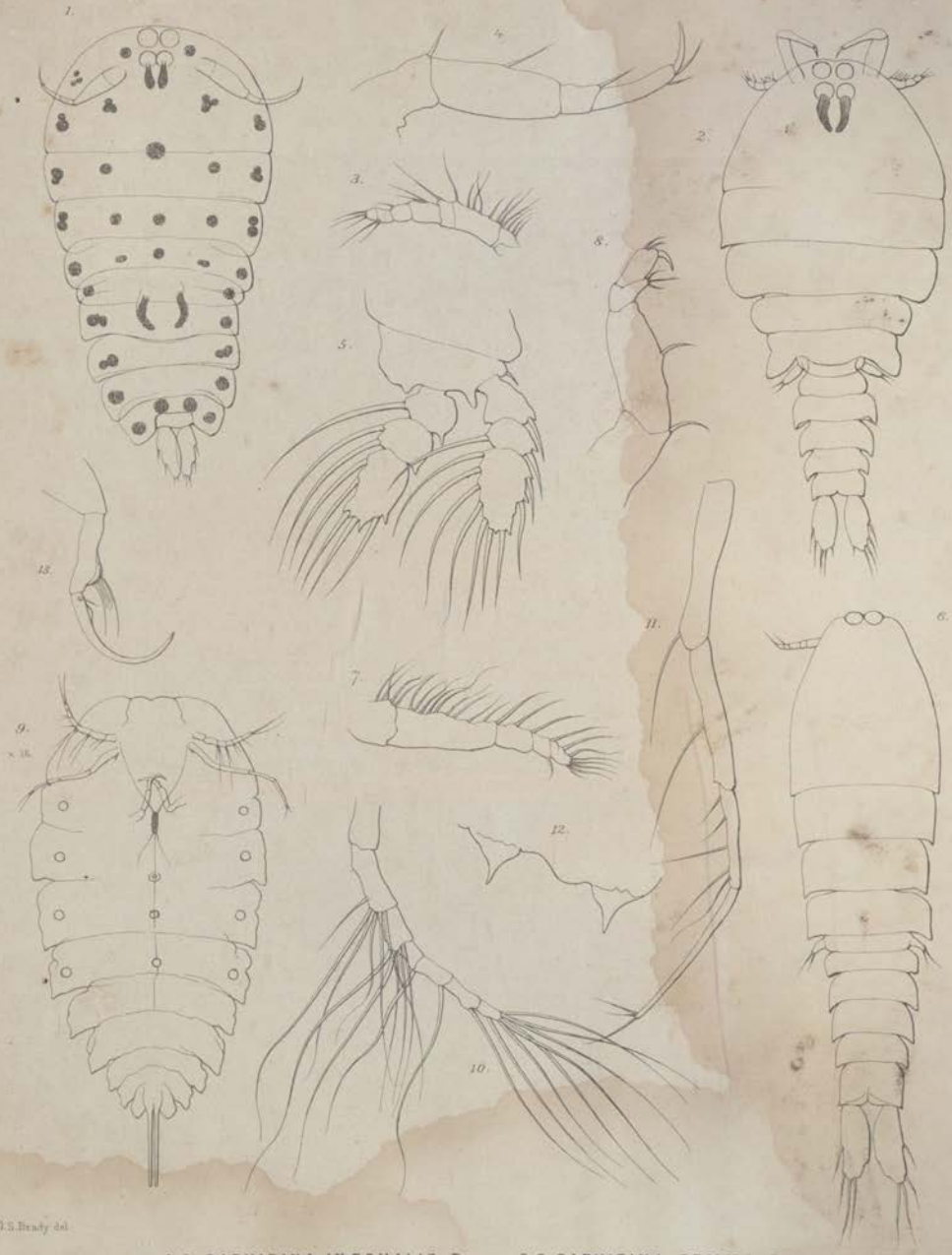
Fig. 9. Male, seen from below; magnified 16 diameters.

Fig. 10. Anterior antenna.

Fig. 11. Posterior antenna.

Fig. 12. Upper lip.

Fig. 13. Posterior foot-jaw.



G.S.Brady del.

1-5 SAPHIRINA INÆQUALIS, Dana. 6-8 SAPHIRINA GEMMA, Dana.
9-13 SAPHIRINELLA STYLIFERA, Lubbock.

PLATE XLIX.

PLATE XLIX.

Figs. 1, 2. *Saphirina serrata*, n. sp.

Fig. 1. Female, seen from above; magnified 40 diameters.
Fig. 2. Hinder segments and caudal lamellæ of male, more highly magnified.

Figs. 3–6. *Saphirina opalina*, Dana.

Fig. 3. Female (? young), seen from above.
Fig. 4. Posterior portion of an adult, both magnified 40 diameters.
Fig. 4. *a*, Posterior portion of the abdomen of male (?).
Fig. 5. Anterior antenna.
Fig. 5. *a*, Anterior antenna of male (?).
Fig. 6. Posterior antenna.

Figs. 7–10. *Saphirina sinuicauda*, n. sp.

Fig. 7. Posterior antenna.
Fig. 8. Last joint, inner branch of second (?) swimming foot.
Fig. 9. Abdomen and caudal stylets of female.
Fig. 10. Posterior abdominal segments and caudal stylets of male.

Figs. 11–13. *Saphirina splendens*, Dana.

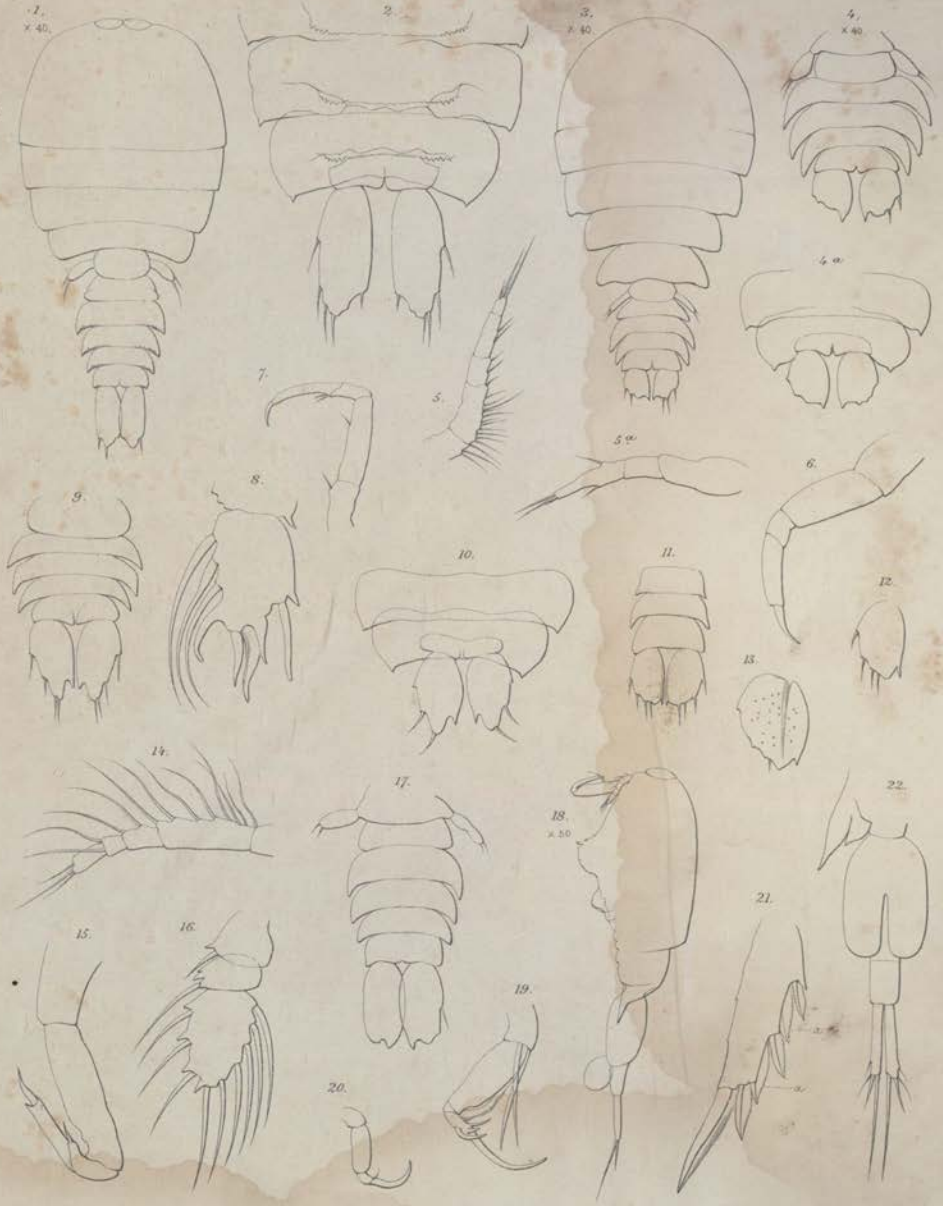
Fig. 11. Abdomen of immature (?) female.
Fig. 12. Caudal lamella of the same.
Fig. 13. Caudal lamella of male (setæ wanting).

Figs. 14–17. *Saphirina opaca*, Lubbock.

Fig. 14. Anterior antenna.
Fig. 15. Posterior antenna.
Fig. 16. Outer branch of one of the swimming feet.
Fig. 17. Abdomen and last cephalothoracic segment of female.

Figs. 18–22. *Corycæus limbatus*, n. sp.

Fig. 18. Female, seen from left side; magnified 50 diameters.
Fig. 19. Posterior antenna.
Fig. 20. Posterior foot-jaw.
Fig. 21. Last joint of one of the swimming feet, with magnified spines.
Fig. 22. Posterior thoracic spines, with abdomen and tail.



G. S. Brady del.

Y. Kuth. lith. Edin.

1, 2 SAPHIRINA SERRATA, n. sp. 3-6 S. OPALINA, Dana. 7-10 S. SINUICAUDA, n. sp.
11-13 S. SPLENDENS, Dana. 14-17 S. OPACA, Lubbock. 18-22 CORYCÆUS LIMBATUS, n. sp.

PLATE L.

PLATE L.

Figs. 1–10. *Setella gracilis*, Dana.

Fig. 1. Female, seen from left side; magnified 80 diameters.

Fig. 2. Anterior antenna of male.

Fig. 3. Posterior antenna.

Fig. 4. Mandible.

Fig. 5. Maxilla.

Fig. 6. Anterior foot-jaw.

Fig. 7. Posterior foot-jaw.

Fig. 8. One of the swimming feet.

Fig. 9. Foot of fifth pair, male.

Fig. 10. The same, female.

Figs. 11–17. *Saphirina metallina*, Dana.

Fig. 11. Male, seen from above.

Fig. 12. Female, seen from above; both magnified 40 diameters.

Fig. 13. Anterior antenna.

Fig. 14. Posterior antenna.

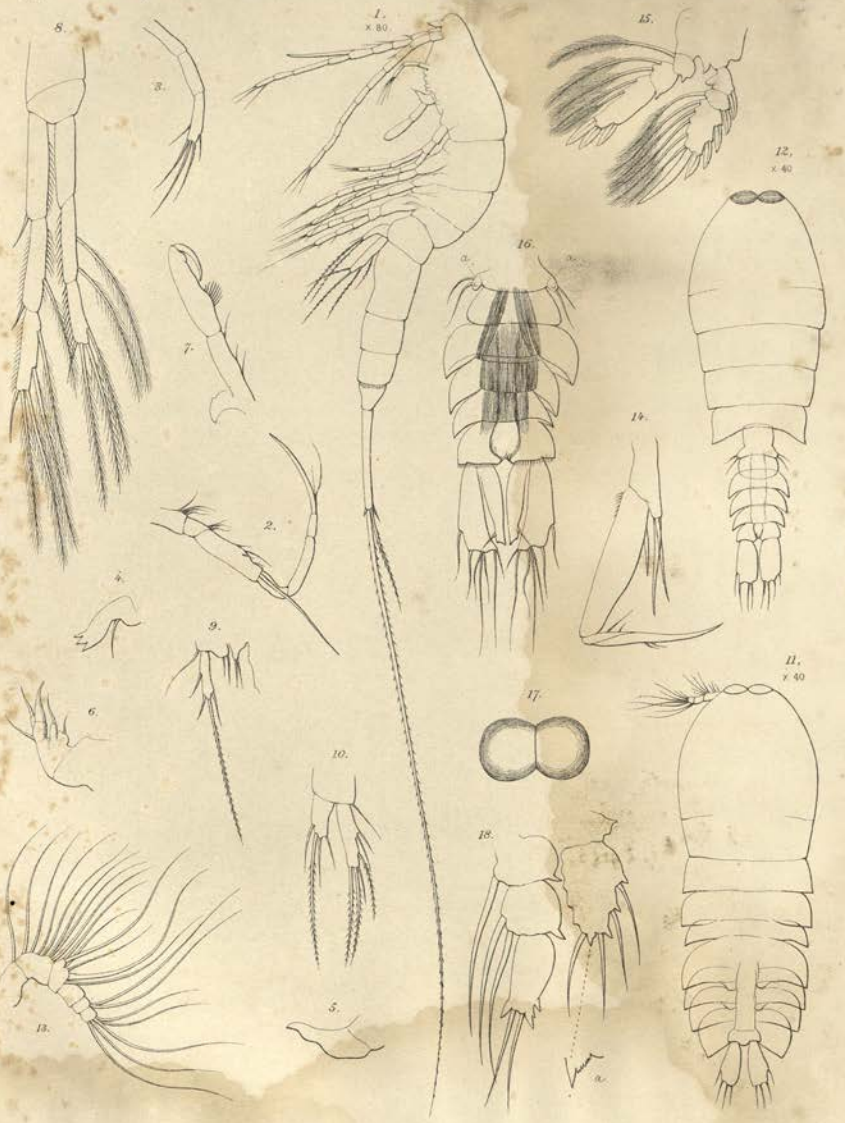
Fig. 15. Foot of fourth pair.

Fig. 16. Abdomen of female, more highly magnified.

Fig. 17. Corneal lenses.

Fig. 18. *Saphirina gemma*, Dana.

Fig. 18. Inner branch and portion of outer branch of one of the swimming feet; *a*, one of the apical spines, more highly magnified.



G.S. Brady del. F. Huth Lith. S.Fin.

I-10 SETELLA GRACILIS, Dana. II-17 SAPHIRINA METALLINA, Dana.
18 SAPHIRINA GEMMA, Dana.

PLATE LI.

PLATE LI.

Figs. 1–11. *Oncæa obtusa* (Dana).

Fig. 1. Female, seen from right side; magnified 80 diameters.

Fig. 2. Abdomen of female, seen from the front.

Fig. 3. Abdomen of male, seen from the front.

Fig. 4. Anterior antenna.

Fig. 5. Posterior antenna.

Fig. 6. *a*, Mandible; *b*, maxilla.

Fig. 7. Anterior foot-jaw.

Fig. 8. Posterior foot-jaw of female.

Fig. 9. Posterior foot-jaw of male.

Fig. 10. Foot of first pair.

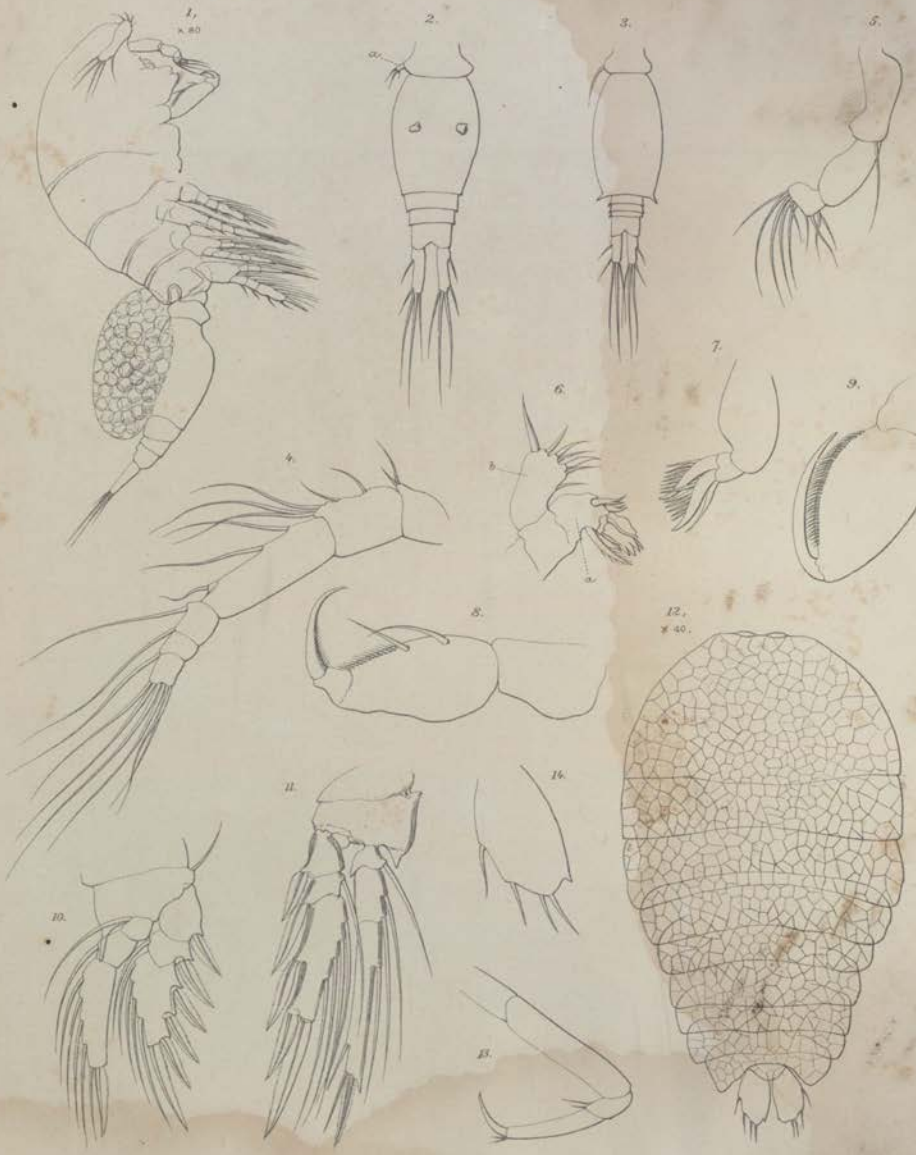
Fig. 11. Foot of fourth pair.

Figs. 12–14. *Saphirina reticulata*, n. sp.

Fig. 12. Male, seen from above; magnified 40 diameters.

Fig. 13. Posterior antenna.

Fig. 14. A caudal lamella, more highly magnified.



G.B. Brady del.

F. Huth, Lith^r Edin^r

1-11 ONCÆA OBTUSA, Dana. 12-14 SAPHIRINA RETICULATA, n. sp.

PLATE LII.

PLATE LII.

Figs. 1–14. *Corycæus varius*, Dana.

Fig. 1. Female, seen from above; *a*, lateral processes of third thoracic segment.

Fig. 2. The same, seen from left side; both magnified 40 diameters.

Fig. 3. Abdomen of female, seen laterally.

Fig. 4. Abdomen of male, seen from the front.

Fig. 5. Abdomen of immature female, seen from the front.

Fig. 6. Anterior antenna.

Fig. 7. Posterior antenna of male.

Fig. 8. Posterior antenna of female.

Fig. 9. *a*, Mandible; *a'*, *a'*, apical processes; *a''*, palp; *b*, maxilla.

Fig. 10. Anterior foot-jaw.

Fig. 11. Posterior foot-jaw.

Fig. 12. Foot of first pair.

Fig. 13. Foot of third pair.

Fig. 14. Foot of fourth pair.

Figs. 15–19. *Corycæus pellucidus*, Dana.

Fig. 15. Female, seen from left side; magnified 80 diameters.

Fig. 16. Anterior antenna.

Fig. 17. Posterior antenna.

Fig. 18. Posterior foot-jaw.

Fig. 19. Abdomen and tail with attached spermatophores.

G.S. Brady del. F. Ruth. Lith. Edin.

1-14 CORYCÆUS VARIUS, Dana. 15-19 C. PELLUCIDUS, Dana.

PLATE LIII.

PLATE LIII.

Figs. 1–11. *Copilia mirabilis*, Dana.

Fig. 1. Female (?), seen from above.

Fig. 2. The same, seen from right side; both magnified 40 diameters.

Fig. 3. Anterior antenna.

Figs. 4, 5. Posterior antenna of male and female (?)

Fig. 6. Mandible.

Fig. 7. Maxilla (?).

Fig. 8. Anterior foot-jaw.

Fig. 9. Posterior foot-jaw.

Fig. 10. Foot of first pair.

Fig. 11. Foot of fourth pair.

Figs. 12–16. *Lubbockia squillimana*, Claus.

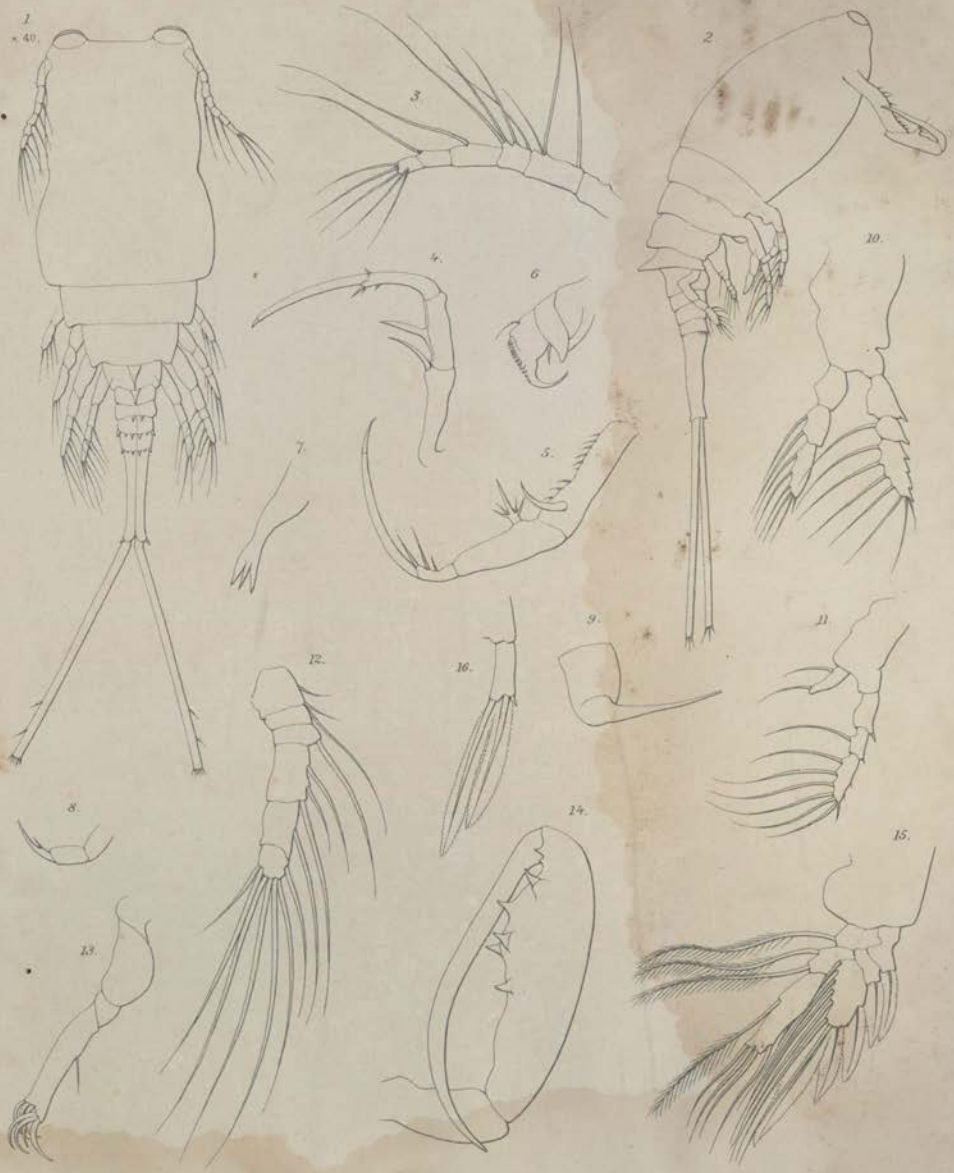
Fig. 12. Anterior antenna of female.

Fig. 13. Posterior antenna.

Fig. 14. Posterior foot-jaw of female.

Fig. 15. One of the swimming feet.

Fig. 16. Foot of fifth pair.



G.S. Brady del. J. Roth, Lith.t Edin.t

1-11 COPILIA MIRABILIS, Dana. 12-16 LUBBOCKIA SQUILLIMANA, Claus.

PLATE LIV.

PLATE LIV.

Figs. 1–7. *Lubbockia squillimana*, Claus.

Fig. 1. Female, seen from above.

Fig. 2. The same, seen from left side.

Fig. 3. Male, seen from above.

Fig. 4. The same, seen from left side; all magnified 80 diameters.

Fig. 5. Mandible.

Fig. 6. Anterior foot-jaw.

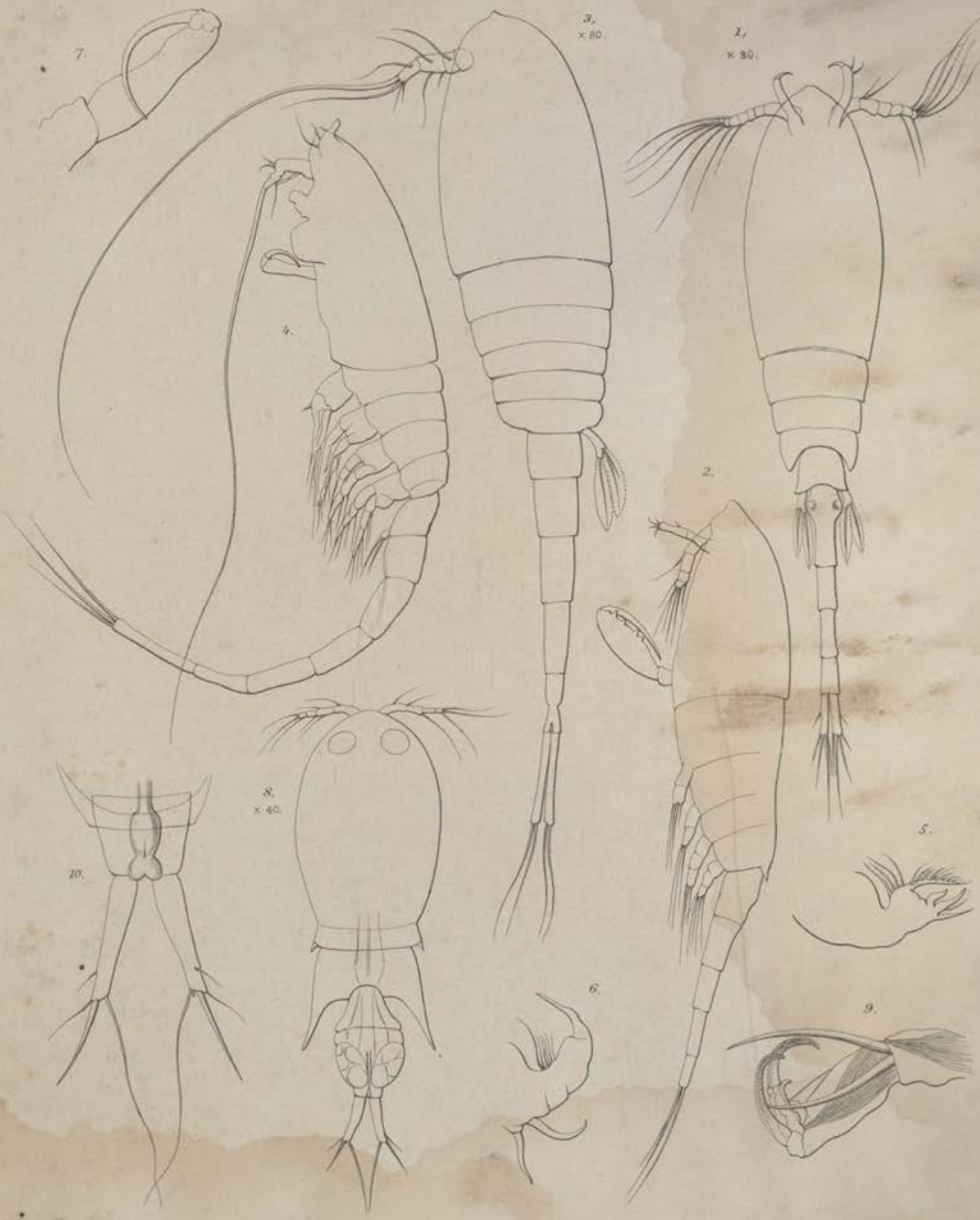
Fig. 7. Posterior foot-jaw of male.

Figs. 8 10. *Corycæus venustus*, Dana.

Fig. 8. Female, seen from above; magnified 40 diameters.

Fig. 9. Posterior antenna.

Fig. 10. Last abdominal segment and tail.



G.S. Brady del.

Y. Reh. Lith. Edin.

1-7 LUBBOCKIA SQUILLIMANA, Claus. 8-10 CORYCÆUS VENUSTUS, Dana.

PLATE LV.

PLATE LV.

Fig. 1. *Nogagus murrayi*, n. sp.

Fig. 1. Adult female (?), seen from below; magnified 20 diameters.

Fig. 2. *Lepeophtheirus suhmi*, n. sp.

Fig. 2. Female, seen from below; magnified 24 diameters.

Fig. 3. *Pandarus zygænæ*, n. sp.

Fig. 3. Adult male, seen from above; magnified 16 diameters.

Figs. 4–8. *Chondracanthus macrurus*, n. sp.

Fig. 4. Adult, magnified 16 diameters.

Fig. 5. Posterior antenna.

Figs. 6, 7. Mouth-organs.

Fig. 8. Foot-jaw ?

Figs. 9–13. *Hessella cylindrica*, n. gen. and sp.

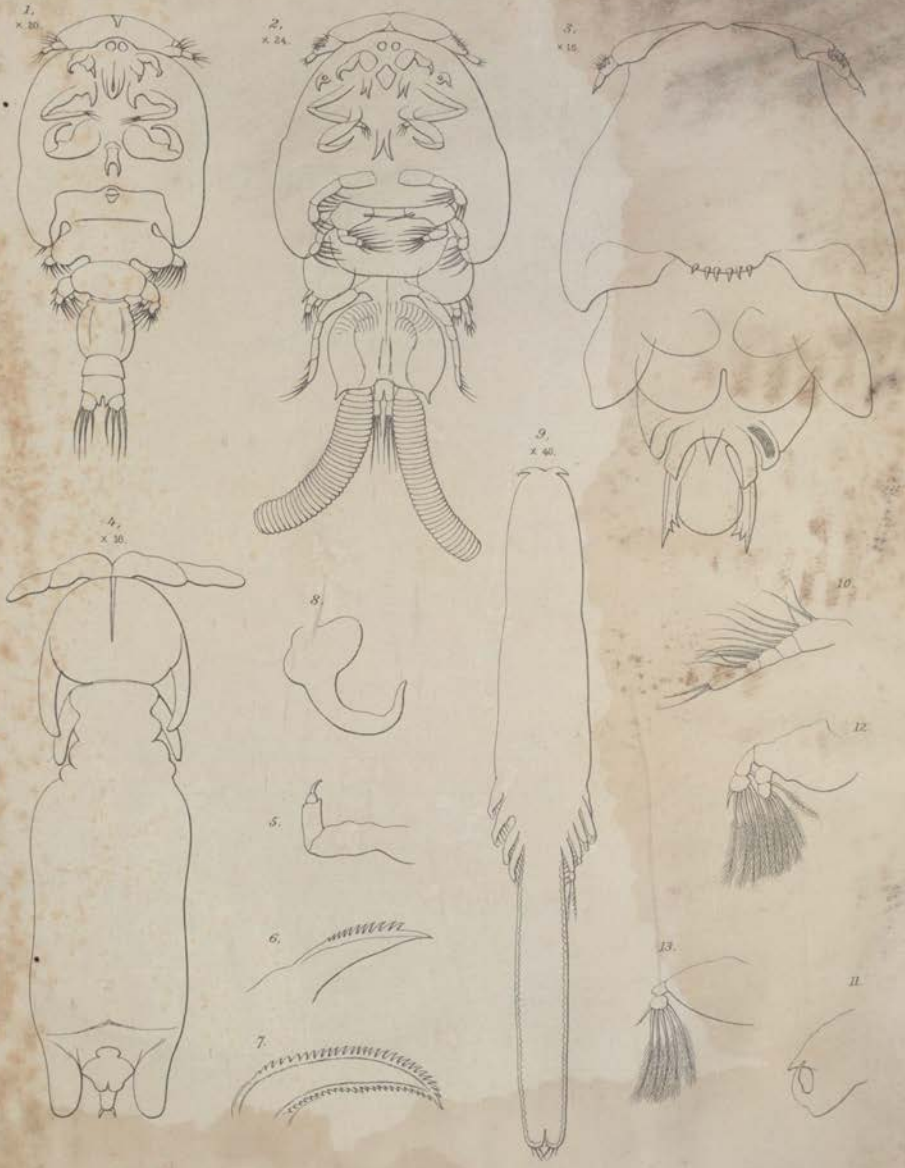
Fig. 9. Adult, magnified 40 diameters.

Fig. 10. Anterior antenna.

Fig. 11. Posterior antenna (?).

Fig. 12. Foot of first pair.

Fig. 13. Foot of third pair.



1. NOGAGUS MURRAYI, n. sp. 2. LEPEOPHTHEIRUS SUHMI, n. sp. 3. PANDARUS ZYGÆNÆ, n. sp.
4-8. CHONDRACANTHUS MACRURUS, n. sp. 9-13. HESSELLA CYLINDRICA, n. gen. & sp.

THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the CALCAREA dredged by H.M.S. Challenger during the years 1873–76. By N. POLÉJAEFF, M.A. of the University of Odessa.

INTRODUCTION.

IN December 1882 I received from Mr. John Murray, for the purpose of scientific investigation, all the Calcarea brought home by the Challenger Expedition. The investigation has been conducted in Graz, at the Institute of Prof. F. E. Schulze, and indebted as I am to Prof. F. E. Schulze for the whole of my spongiological education, I am now still more under obligation to him for the encouraging interest which he has manifested in the progress of this investigation, for his liberality in placing at my disposal all his own Calcarea, and for the kindness with which he procured me access to the precious collection which Prof. Oscar Schmidt presented to the Joanneum at Graz. For all this I express to Prof. F. E. Schulze my heartfelt gratitude. I have also to fulfil the agreeable obligation of thanking Dr. E. v. Marenzeller of Vienna, Prof. J. Steenstrup of Copenhagen, Dr. G. C. J. Vosmaer of Naples, and particularly Mr. H. J. Carter of Budleigh-Salterton, for the amiability with which my requests, if in any way realisable, were received and answered.

The Calcarea of the Challenger Expedition have been found to belong to thirty species, twenty-three of which are quite new. The greater part of the specimens being very well preserved, and there being amongst them many very interesting forms, I considered it my duty not to limit myself to a simple description of the collected material, but to try to solve some questions which, thanks to recent investigations, have been brought before the scientific world. The principal question, which logically includes in

itself all the others, concerns the systematic arrangement of the class Calcarea, proposed by Prof. Hæckel in his monograph, Die Kalkschwämme.

Although it is twelve years since this work made its appearance, yet no serious attempt has been hitherto made to criticise Prof. Hæckel's systematic principles, although there has been no want of consciousness that such an attempt was desirable. Some zoologists, it is true, captivated by the ingenuity of the system established by Hæckel, not only proclaimed the Monograph an "Epoche machendes Werk" (Keller), which I quite agree with, but went so far as to express their conviction that there could be nothing further added to the natural history of the class Calcarea, all having been done by the illustrious professor of Jena. Other voices, however, were heard, which spoke of the necessity of a revision; as for instance, those of Leuckart, P. Wright, and more decidedly Metschnikoff and Claus.

A complete revision of all the Calcarea described up to this time is at present scarcely possible. The originals are scattered over all Europe, if not over the whole world, and some of them are not to be obtained at all. I have done my utmost in this direction, and I think that, including the Challenger specimens, the number of forms at my disposal is sufficient to permit me to hope that the systematic arrangement of the group Calcarea here proposed will serve as a sufficiently sure basis for further investigations.

I limit myself in this paper to a revision of the families and genera, this being the most important part of the task. With respect to the species established by Hæckel and later investigators, I am disposed on the whole to accept them. There are among them some doubtful ones, but a discussion of these would lead me beyond the range of my proper work, and I defer it to another opportunity. I think it also superfluous to give here a historical report of the literature of the group. Prof. Hæckel's Monograph gives this very amply up to the date of its publication, and the memoirs of the last twelve years being principally embryological, I shall refer to them, when necessary, in the sequel. A short historical report is also to be found in Dr. Vosmaer's paper on *Leucandra aspera*.[1]

In accordance with the above, I propose to divide my memoir into two chapters; the first will be devoted to general morphological and systematic questions, the second to the description of the forms collected during the cruise of the Challenger.

[1] Aanteekingen over Leucandra aspera, &c., Leiden 1880, pp. 1–34.

I.—MORPHOLOGICAL OBSERVATIONS.

In the class of Calcarea, Prof. Hæckel distinguishes three families—Ascones, Sycones, and Leucones, characterising them according to the properties of their canal system. In each family he establishes seven genera, taking the character of the spicules (whether triradiate, quadriradiate, or acerate) as the generic character, seven combinations being thus possible. The form of the spicules is reserved for the establishment of specific characters. The classification constructed upon these principles Prof. Hæckel calls "natural,"[1] and puts it in opposition to his former classification published in the year 1869.[2] It cannot be denied that in comparison with the system of the Prodromus, the arrangement proposed in the Monograph is a great advance; the arrangement of the Monograph, although still rather artificial, is incomparably more natural than that of the Prodromus, and shows that its author had made great progress in the recognition of the organisation of the calcareous sponges. There is, however, a great difference between a *more* natural and a *really* natural system. A natural system is the last link of a long chain of investigations, it is the crown of all former studies, it becomes possible only when the majority of the representatives of a group of animals has been examined and described. The very fact that of the thirty species brought home by the Challenger Expedition, twenty-three present quite new forms, proves clearly how few Calcarea we know, and how very many forms are still to be discovered. And therefore, till the right time comes for making a summary of our knowledge, nothing but attempts at a natural arrangement can be given. The system of Prof. Hæckel is no essay. Having founded his genera upon all the possible combinations of the three kinds of spicules, he thereby restricted the number of genera for ever, and, even though he had been thoroughly justified in this by the forms he had for examination, he would still have been premature in classifying the Calcarea in the manner he did. But it is sufficient to peruse the Monograph attentively in order to find that the justification just mentioned did not exist. For instance, characterising one species of Leucones—*Leucetta corticata*—Prof. Hæckel writes as follows:—"*Leucetta corticata* is one of the most peculiar Leucones, and possesses a near ally only in *Leucaltis clathria*."[3] The same, *mutatis mutandis*, is said

[1] Kalkschwämme, Bd. i. p. 79.

[2] Prodromus eines Systems der Kalkschwämme, *Jenaische Zeitschr.*, Bd. v. pp. 236–254, 1870.

[3] Kalkschwämme, Bd. ii. p 130.

in the description of *Leucaltis clathria*,[1] and yet in his system *Leucetta corticata* belongs to one genus, *Leucaltis clathria* to another. In the hypothetical genealogical tree of the genera of his natural system Prof. Hæckel assigns a different origin to the species belonging to the same genus, as for instance, deriving the species of the genus *Ascortis* partly from the genus *Ascandra*, partly from the genus *Ascetta*; the species of the genus *Ascandra* partly from *Ascaltis*, partly from *Ascortis*, &c. Nevertheless, all the species of *Ascortis* or *Ascandra* are, according to him, to be united in one genus, not to be divided into two or more—a direct contradiction to the description Prof. Hæckel gives of his system in the words :—"constructed upon the phylogenetical principles of the theory of descent (ausgeführt nach den phylogenetischen Principien der Descendenz-Theorie").[2] Being further obliged to acknowledge the great variability of the spicules with respect to their character whether triradiate or quadriradiate, as well as the inconstancy in the presence of the acerate form, Prof. Hæckel creates a new kind of variety, which he calls "connexive," and regards as illustrating the transition of one genus into another, and he asserts that these "connexive" varieties are "exceedingly instructive for the understanding of the origin of species (höchst lehrreich für die Erkenntniss des Ursprungs der Arten"[3]). This would indeed be very instructive, if there were in the Monograph a successful attempt to prove that the seven genera of each of the three families of Calcarea are really natural; such an attempt would have been especially desirable, for in some species presenting "connexive" varieties the constancy in the form of their spicules is comparatively pronounced (*Ascetta primordialis*, *Leucetta primigenia*), and one might come to the conclusion that the generic character is in some cases more variable than that distinguishing the species. The proofs in question, however, are not to be found; the words "natural genus," "natural species," are used repeatedly, and the "naturalness" of the new system is very often urged, but there is only one passage in the whole Monograph which, although by no means proving the naturalness of Prof. Hæckel's system, alludes to the manner in which its author arrived at his systematic ideas. In the year 1871, on the coast of Lesina, Hæckel happened to find many colonial specimens of an Ascon which was composed partly of *Clathrina clathrus*, O. Sch., and partly of *Nardoa labyrinthus*, O. Sch., *i.e.*, of two forms which, found growing separately by O. Schmidt, had been referred by him to two quite different genera. Both the sponges grew into each other without any definite boundary, and a close investigation showed that throughout the whole colony the spicules were of precisely the same form.[4] Oscar Schmidt, in referring his *Clathrina clathrus* and *Nardoa labyrinthus* to two different genera, was guided by their external differences. The discovery of Prof. Hæckel proved that such guidance is very uncertain, and so far as this discovery caused him entirely to abandon the principles of classifying the calcareous sponges previously adopted, this discovery must be called very fortunate; but if Prof. Hæckel

[1] Kalkschwämme, Bd. ii. p. 159. [2] *Loc. cit.*, p. 5. [3] *Loc. cit.*, p 23. [4] *Loc. cit.*, p. 33.

came to his later systematic ideas really in consequence of the discovery just mentioned, the medal has a reverse. For, having adopted the principle of classification according to the spicules, Prof. Hæckel fell into the same error which characterises the system adopted in the Prodromus. The difference between a colony of Calcarea, in which, according to their spicular characters, one individual belongs to one genus, the other to another, and a genus such as *Thecometra* or *Sycometra* of the Prodromus, is of quantitative not qualitative nature. The existence of such colonies is indeed very instructive, but it proves nothing but the great variability of the spicules, nothing but the utter impossibility of giving to the presence or absence of quadriradiate or acerate spicules the significance of a generic character.

The interesting experiments of Schmankewitsch are certainly still present in the memory of every zoologist. They aroused great attention, and there was considerable doubt as to their reliability. But they merely amounted to a demonstration of the transition of one *species* into another, under the influence of *different* conditions. Now, in *Ascaltis darwinii*, *Ascandra lieberkühnii*, and in *Ascandra variabilis*, we have, according to Hæckel, to deal with colonial forms, which, under the *same* conditions, consist partly of the representatives of one *genus*, partly of another. As I said before, there is in the Monograph no trace of an argument to prove the naturalness of its twenty-one genera. I have only to add that, had such an attempt been made, and had the argument been lucid and logical, yet in view of such examples every impartial investigator would look on it with distrust, and consider the argument to be sophistical. Prof. Hæckel calls his system "natural," but no system paying attention to but one character and not to the whole organisation can claim that designation. And so far as concerns its twenty-one genera, the system proposed by Prof. Hæckel, however ingenious, is yet not less artificial than that of the animal kingdom established by Linné. I do not consider it necessary to dwell longer on this question, but formulate my conclusion thus:—

The spicules of Calcarea being very variable in every direction, could not serve as a basis for the distinction of genera, even if there were in the calcareous sponges no other characters fit for very distinct systematic definitions.

I pass on to the other characters. One of them—the arrangement of the canal system—is used by Prof. Hæckel as a family character.

The great difference between an Ascon, a Sycon, and a Leucon had been already recognised in some measure by the earlier spongiologists (Bowerbank, Lieberkühn, O. Schmidt), although the meaning of the difference was, so to speak, rather dimly felt, not appreciated at its full value. It is the great merit of Prof. Hæckel that he laid stress upon these differences, the more so because, as we shall see, his knowledge of the internal organisation of Calcarea was far from perfect. With respect to the Ascones, I have nothing further to say, Prof. Hæckel's erroneous opinion upon their histological structure, as well

as upon the histology of the Calcarea in general, having been already refuted by the investigations of F. E. Schulze,[1] Metschnikoff,[2] and Vosmaer.[3] Everybody feels now convinced that all the Calcarea, like other sponges, possess an ectoderm, mesoderm, and endoderm, and that what Hæckel calls "exoderm" is ectoderm and mesoderm together. I would only call attention to one histological peculiarity stated by Hæckel to be present in some Ascones, viz., to the presence in certain varieties of *Ascetta primordialis*, *Ascetta clathrus*, *Ascaltis canariensis*, and *Ascaltis lamarckii*, of *several* layers of endodermic cells.[4] Some more precise statements on this point are very desirable.

There remains a good deal more to be said about the organisation of Sycones and Leucones, particularly of the latter. The pages of the Monograph dedicated to the canal system of the Leucones (Bd. i. pp. 224–237) are among the weakest portions of the whole work. Prof. Hæckel did not succeed in making out the real features of their organisation. This, however, might have been expected. A true and clear exposition of the anatomical structure of the sponge, in its chief modifications, being the merit of Prof. F. E. Schulze exclusively, is an acquisition of the last ten years. Everyone is a son of his time, and now, though we find many of Prof. Hæckel's conceptions to be erroneous, we must not forget that, compared with the very imperfect ideas of Bowerbank, O. Schmidt, and others upon the same subject, they represented in their time a considerable advance, and rendered subsequent investigations possible. There were, besides, some other causes whose retarding influence must be noticed. I speak of Prof. Hæckel's phylogenetic hypothesis with respect to the derivation of Sycones and Leucones from Ascones: the Sycones by means of strobiloid gemmation, the Leucones by means of the thickening of walls and the ramification of the canals.[5]

I turn firstly to the Sycones. Having adopted the idea that every radial tube of a Sycon represents an Ascon, Hæckel naturally sought after a homologue to the osculum; he believes it to be found in the large "dermal ostium" on the tubes of *Sycetta primitiva*, *Sycaltis perforata*, and some other species of Sycones[6] and lays stress upon their morphological significance, ascribing to them also an important physiological function. According to him, these conjectural "dermal ostia" are in some cases the only openings through which water runs into the interior of the radial tubes. Such was the way in which Hæckel was led to his statement as to the existence of "intercanalless Sycones," under which category he described the following forms:—*Sycetta stauridia*, *Sycilla cyathiscus*, *Sycilla cylindrus*, *Sycilla urna*, *Sycilla chrysalis*, *Sycyssa huxleyi*, *Sycaltis glacialis*, *Sycaltis testipara*, *Sycaltis ovipara*, *Sycaltis perforata*, *Sycortis lævigata*, *Syculmis synapta*,

[1] Ueber d. Bau u. d. Entwickel. v. Sycandra raphanus, *Zeitschr. f. wiss. Zool.*, Bd. xxv. Suppl. p. 247, 1875; Die Metamorph. v. Sycandra raphanus, *ibid.*, Bd. xxxi. p. 290, 1878.

[2] Spongiologische Studien, *ibid.*, Bd. xxxii. p. 349, 1879.

[3] Ueber Leucandra aspera, &c., *Tijdschr. d. Ned. Dierk. Vereen.*, Dl. v. p. 144, 1881.

[4] Kalkschwämme, Bd. i. p. 144. [5] *Loc. cit.*, p. 340. [6] *Loc. cit.*, p. 260.

Sycandra arctica, *Sycandra ramosa*, *Sycandra compressa*, *Sycandra utriculus*, and *Sycandra hystrix*. For my own part I must emphatically deny their "intercanalless" nature. It will be proved later that the seventeen species just named belong not to seven, but only to three genera, *Sycon*, *Grantia*, and *Amphoriscus*. I found amongst the Challenger sponges the representatives of all the three genera. I had examined also *Sycon utriculus* (*Sycandra utriculus*, H.), *Grantia compressa* (*Sycandra compressa*, H.), and *Amphoriscus chrysalis* (*Sycilla chrysalis*, H.), and wish to lay stress upon the fact that the specimens of *Sycon utriculus* and *Amphoriscus chrysalis* were obtained from the collections revised twelve years ago by Prof. Hæckel himself, and that *Grantia compressa* is a sponge so well known that there can be no doubt that the specimens I have had for investigation belonged to this species. Though not nearly so regular as in some other cases, the intercanals could always be very easily found—their course in *Sycon arcticum* and *Grantia tuberosa* is represented in Pl. III. figs. 5 and 6, in *Amphoriscus poculum* and *Amphoriscus elongatus* in Pl. IV. figs. 4 and 5. And there is no doubt that what Hæckel declares to be "dermal ostia" and "dermal pores" in the individuals of his "Syconusa-type" were merely the pores of the intercanals, and that what he calls "conjunctive pores" (*loc. cit.*, p. 260), these latter uniting, according to him, the cavities of the radial tubes, were nothing but the common pores on the side-walls of the radial tubes connecting these latter with the intercanals. To any one who will notice Prof. Hæckel's remark (*loc. cit.*, Bd. i. p. 248) that these "conjunctive pores" are best to be observed in sections of *dry* Sycones, the error into which he fell will be easily comprehended. The refutation of these erroneous statements has not only an anatomical, but also a systematic weight. There is in the genus *Sycandra* a whole sub-genus, whose principal character is, according to Hæckel, the non-existence of the intercanals, and I fancy I am very near to the truth in my supposition that it was merely the finding of quite evident intercanals which induced Dr. Vosmaer, in his report on the sponges collected by the "Willem Barents,"[1] to put a query before his diagnosis of the three Calcarea determined by him as *Sycandra compressa*, *Sycandra utriculus*, and *Sycandra arctica* (*loc. cit.*, p. 4). These three Sycones possess such a characteristic set of spicules that I really cannot find any other explanation, except the above mentioned, for Dr. Vosmaer's remark that the specimens in question being very small he could not obtain sections enough for a thorough examination.

With regard to the Leucones, there are in Prof. Hæckel's Monograph still more serious errors. He distinguishes four modifications of their canal system. The first modification is termed "dendroid" ("baumförmig"), and is characterised as follows:—"The dendroid type is the most primitive and simple, but nevertheless the rarest modification. It is to be found in *Leucetta primigenia*, *Leucyssa cretacea*, *Leucandra*

[1] Vosmaer, Report on the Sponges dredged up in the Arctic Sea by the "Willem Barents," in the years 1878 and 1879, *Niederländ. Archiv f. Zool.*, Supplement-Bd. i. 1882.

bomba, and some other species. Beginning with the gastric surface, we find here numerous large canals, which ramify tolerably regularly, like the branches of a tree, towards the dermal surface. The branches, broad at their beginning, become smaller and more numerous in their course towards the dermal surface, and pass at last into the finest small canals, opening by pores on the dermal surface. The canals are, either throughout their whole extent or for the greater part of it, covered with flagellated endodermal cells. Only the outermost ends of the finest canal-branches (near the dermal pores), and the innermost ends of the largest canal-trunks (near the gastric cavity), remain free from the flagellated epithelium. The anastomoses of the branches are either wanting altogether or few in number."[1] The diagram illustrating this description refers to *Leucandra bomba* (*loc. cit.*, Bd. iii., pl. xl. fig. 9). I was not able to obtain this sponge. I hoped to find it in the Godeffroy Collection in Hamburg, which was kindly sent to me by the administration of the museum; but this expectation was not realised. I found, however, amongst the Challenger Calcispongiæ three specimens of *Leucetta primigenia*, of a form even more instructive with respect to the question of the existence of the dendroid canal system than *Leucandra bomba*. "*Leucetta primigenia*," says Hæckel,[2] "as the conjectural radical form of the Leucones, is so closely allied in the properties of its skeleton to the general radical form of all the Calcarea, *i.e.*, *Ascetta primordialis*, that it can be derived immediately from this latter. The wall of *Ascetta primordialis* requires only to grow thicker, its variable dermal pores require only to become constant canals, and to ramify in the wall, in order to realise the transformation of *Ascetta primordialis* into *Leucetta primigenia*." We shall soon see that Leucones have had quite a different course of development; at any rate, with regard to the canal system of *Leucetta primigenia*, Prof. Hæckel's statements do not correspond with the reality. A close examination of the three specimens above mentioned showed that their canal system possesses just the same character, and, with the exception of some trifling differences, the same peculiarities as that of *Spongelia*, *Aplysilla*, &c. Its detailed description will be given later; at present we have only to notice that a dendroid modification of the canal system does not exist at all.

"The retiform ('netzförmig') modification of the canal system takes origin from the dendroid in the following manner: the anastomoses of the ramifying canals grow more numerous and occur not only between the finer branches, but also between the larger ones. When this structure has obtained its highest development, the wall-parenchyma of a Leucon seems to be pierced by a dense net of canals, like a gland rich in blood-vessels. This modification is not rare . . . . . it is to be found, for instance, in *Leucetta trigona*, *Leucaltis crustacea*, *Leucandra cataphracta*, and *Leucandra stilifera*." In these words Hæckel describes his "retiform" type, illustrating it by a diagram referring to *Leucandra stilifera;* but I am forced to deny its existence, as also that of the

[1] Kalkschwämme, Bd. i. p. 228.

[2] *Loc cit.*, Bd. ii. p. 122.

dendroid type. I submitted *Leucandra stilifera* and *Leucandra cataphracta* to a careful examination, and can find no essential difference between their canal system and that of *Leucetta primigenia*. The distinctions merely concern the size of the flagellated chambers, the average width of the exhalent and inhalent canals, &c., all which is of little consequence. In both cases the constituent parts of the canal system are the same, viz., inhalent canals, flagellated chambers, and exhalent canals, and the properties of these component parts do not differ from those in *Aplysilla*, *Reniera*, &c.

Prof. Hæckel's third type of canal system, called by him "racemose" ("traubenförmig"), corresponds more closely with the reality. This is illustrated by eight diagrams referring to *Leucandra ananas* (*loc. cit.*, Bd. iii., pl. xl. figs. 1–8). Here we have for the first time in the Monograph to deal with real inhalent canals, flagellated chambers, and exhalent canals. Still, so far as concerns the properties of these three constituent parts, the description is erroneous, as has already been pointed out by Dr. Vosmaer with respect to *Leucandra aspera*,[1] and *Leucaltis solida*.[2]

Prof. Hæckel describes his "racemose" type as follows :—"The branch-canals, which proceed from the gastric surface, and ramify centrifugally towards the dermal surface, are in certain places dilated into vesicles, mostly spherical in form, and it is only these swellings or chambers which are covered on their inner surface with flagellated epithelium, this latter being completely absent from all the other surfaces of the canal system."[3] Dr. Vosmaer's observations by no means agree with the description just quoted. He states that the inhalent canals, if ramifying, do so exactly in the opposite direction to that indicated by Hæckel, their communication with the outer world being effected by the dermal pores, and with the flagellated chambers by the pores in the walls of these latter; that the flagellated chambers each possess in addition to the pores a larger opening by which the water streams into the exhalent canal system; that these openings are of smaller diameter than that of the corresponding exhalent canal; that, in a word, the canal system of *Leucandra aspera* and *Leucaltis solida* is in its chief characters closely allied to that, for instance, of *Aplysilla*, as described by F. E. Schulze.[4] I thoroughly agree with Dr. Vosmaer's conclusions. In addition to *Leucandra aspera* and *Leucaltis solida*, I examined *Leucandra nivea*, *Leucandra johnstonii*, *Leucandra ananas*, and in all these cases, as well as in all the Leucones of the Challenger collection, I found the structure of the canal system presenting just the same characters. Nor did I find anything that would indicate a modification resembling the fourth and last type, described by Hæckel under the name of "vesicular" ("blasenförmig"), as follows :—"The vesicular type takes origin from the racemose type simply by the extension of the flagellated chambers into larger cavities of irregular outline, which come into

[1] *Niederländ. Archiv f. Zool.*, Suppl.-Bd. i. p. 148, 1882.
[2] Voorloopig berigt omtrent h. onderzoek aan de Nederl. werktafel in h. Zoöl. Stat. te Napels. Haag (?) 1881, p. 5.
[3] Kalkschwämme, Bd. i. p. 231.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxx. p. 406, 1878.

contact with each other and anastomose, thus forming still larger sinus-like spaces."[1] This modification is, according to Hæckel, rare; it is to be found in *Leucilla amphora*, *Leuculmis echinus*, *Leucandra fistulosa*, *Leucandra cucumis*, *Leucetta corticata*, and *Leucaltis clathria;* in the two latter forms, however, it is not so well-marked.[2] The corresponding diagram refers to *Leucandra fistulosa*. The only specimen of this form I was able to obtain proved to be so badly preserved that there was nothing to be seen in the sections but spicules. There were, however, in the Challenger collection, some specimens which compensated me—at least in some degree—for this mischance. In *Leucilla uter*, n. sp., I found a form closely allied to *Leucilla amphora*; on the other hand, *Leucetta vera*, n. sp., and *Leucetta hæckeliana*, n. sp., show such an unmistakably intimate relationship to *Leucaltis clathria*, that there are just differences enough to separate these forms into distinct species.

The corresponding illustrations are given in Pl. VI. fig. 2*a*, and Pl. VIII. figs. 1 and 7. In the forms just mentioned I could discern neither the network of ramifying canals in Hæckel's sense, nor the fusion of the flagellated chambers, the structure of their canal system quite corresponding in its chief characters with that of all other Leucones. However, in one case (*Leucilla uter*) I found the flagellated chambers not to be round, but of an elongated, cylindrical form, and also of much larger dimensions than usual; and in another case (*Leucetta vera*) there were the smaller, more roundish chambers in addition to the cylindrical ones. I fancy that Prof. Hæckel must have seen something of this kind, and that it was just the difference in the size of the flagellated chambers which gave him the idea of a vesicular type of canal system. I think also that Prof. Hæckel must have had to deal with very badly-preserved specimens, and thus, having had no other guide but his phylogenetic speculations, came to conclusions which, seen from a modern point of view, sometimes appear rather singular.

I might now pass on to the question which has necessitated this digression, viz., the systematic value of the properties of the canal system, but that can be answered thoroughly only when we have acquired a perfectly clear conception as to the phylogenetic relations subsisting between the three families of Calcarea.

As I remarked before, Prof. Hæckel considers the Sycon to be equivalent to a colony of Ascones, which has originated by means of a *strobiloid* gemmation. According to him, every radial tube of the Sycon is the homologue of a whole Ascon, its conjectural dermal ostium a homologue of the osculum, its pores of the pores perforating the wall of an Ascon (comp. *Sycetta primitiva*, Kalkschwämme, Bd. iii. pl. xli.). Now, the case is quite different with regard to the Leucones. According to Hæckel, the Leucon is nothing but an Ascon whose walls have grown thick and whose pores have changed into canals[3]

Prof. F. E. Schulze[4] was the first to pronounce an opinion upon this subject,

[1] Kalkschwämme, Bd. i. p. 234.
[2] Kalkschwämme, Bd. i. p. 235.
[3] Kalkschwämme, Bd. i. p. 347.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxv., Suppl., p. 225, 1875.

denying the possibility of establishing the homology of the Ascon with the radial tube. M. Barrois[1] also, supported by facts drawn from the domain of embryology, remarked the great affinity between Sycones and Leucones, not Ascones; but it is the merit of Dr. Vosmaer[2] to have submitted the question to a detailed and critical examination.

Relying upon the observations of F. E. Schulze and Barrois, as well as upon his own anatomical researches into *Leucandra aspera*, H., Vosmaer urges that the radial tubes are nothing but a kind of flagellated chambers; he refutes the strobiloid gemmation hypothesis, on the ground of the difference in the disposition of the spicules in the radial tubes and in the walls of an Ascon, which had been already made out by Prof. Schulze, and which can be really regarded as a decisive proof against Hæckel's speculative hypothesis. As a second argument against it, he compares the disposition of the anchor-like spicules in *Sycandra raphanus* and in *Syculmis synapta*—an observation also due to Prof. F. E. Schulze, but, as Barrois had already shown,[3] hardly possessing any phylogenetic value. Finally, Vosmaer develops his own views as to the phylogenetic affinities of the three families of Calcarea; and I here quote the most important passages with some abbreviations:—

"The Ascones present the simplest form of the canal system. The thin wall of the sponge consists of three parallel layers, ectoderm, mesoderm, and endoderm. Here and there the cells separate, and thus give origin to the pores (Hæckel's 'Lochcanäle'). The water, flowing along the outer surface, enters through the pores into the interior, and washing the endodermic cells runs out through the osculum. Now, it is evidently advantageous to the sponge, that the surface washed by the water be extensive. One may consequently well imagine any increase in the surface to be a favourable factor in the struggle for existence. If in an Ascon such an extension of the surface, particularly of the layer of the flagellated cells ('in's Besondere der Kragenzellenschicht') take place, the layer just named will form folds and invaginations. Let us suppose that in such a manner small lateral pouches are formed, and again that these pockets grow larger and develop along the whole wall regularly; it is evident that we have before us the picture of a primitive Sycon. All this is quite in harmony with the facts of embryology. Hæckel, Barrois, Schulze, and others, have shown that an Olynthus-phase is passed through in the development of the Sycon, and yet Olynthus is nothing but a primitive Ascon. Lieberkühn had previously observed that the radial tubes are only invaginations of the gastric wall, and that the wall of the radial tubes is covered with flagellated epithelium, which is wanting on the gastric wall of the sponge. That this latter is covered with pavement-cells, Lieberkühn did not know; nor Hæckel either. Schulze first discovered it in the year 1875."[4]

[1] Embryologie de quelques éponges de la Manche, *Ann. d. Sci. Nat.*, sér. 6 (Zool.) t. iii. art. 11, p. 52, 1876.
[2] Ueber Leucandra aspera, *Tijdschr. d. Ned. Dierk. Vereen.* Dl. v., p. 156, 1881.
[3] *Loc. cit.*, p. 31.
[4] *Loc. cit.*, pp. 156, 157.

And further: "Supposing that these invaginations of the gastric wall take place near one another, not so regularly, and that on their walls secondary invaginations arise in their turn; supposing that along with this a stronger growth of the connective tissue takes place, it becomes obvious that the ectoderm and endoderm cannot continue to progress side by side, in other words, that both the layers of epithelium can no more, as in the Ascon and partly in the Sycon, run parallel to each other. We have seen that in the Sycon the flagellated epithelium is confined to the radial tubes alone; if now in the case just mentioned it recede still more, we have the picture of the exhalent canal system of a Leucon. The ectoderm, which at first lay close upon the endoderm, is often displaced from the latter by the connective tissue; it cannot follow the invaginations of the endoderm throughout. And yet both the layers are, so to speak, attracted one to another, and where there is a less quantity of the mesoderm, the original pores break through. One may also picture to oneself the matter in this manner, that the ectoderm in its turn becomes invaginated, and that in this way the primitive form of the inhalent canal system originates. From what has been said above, there follows:—(1) that the radial tubes are a kind of flagellated chambers, although not complete homologues of these; (2) that Sycon being immediately derivable from Ascon, can also change into Leucon; (3) that the so-called simple Leucon is homologous with a simple Sycon or a simple Ascon, each of the three having the value of an individual ('individuum' of the third order)."[1]

If I understand Dr. Vosmaer rightly, he considers Leucones and Sycones to be divergent branches of the same bough of the genealogical tree, although not in the same sense as Prof. Hæckel. It will be proved, by and by, that it is not the case, that Leucones descend from Sycones, still less from a form representing a secondary, not primary, Sycon-type. Independently of this, I completely agree with the first and the third of his conclusions. Like Dr. Vosmaer, I regard the radial tubes as nothing but a kind of flagellated chambers; I also consider a Sycon as well as a Leucon to be homologous with an Ascon. But though agreeing with these two conclusions, I cannot do so with their postulates. Vosmaer says: "Now it is evidently profitable to the sponge that the surface washed by the water be great,' and, considering an eventual extension of the flagellated epithelium-layer to be a favourable factor in the struggle for existence, he tries to explain by it the metamorphosis of an Ascon into a Sycon. This opinion of Dr. Vosmaer has no foundation in fact. He regards a Sycon as better fitted for the struggle for existence than an Ascon. I am forced to remark that had Vosmaer been perfectly logical he would have come to an exactly opposite conclusion. For, compared with an Ascon, a Sycon is more scantily provided with flagellated epithelium: each of its tubes being physiologically equivalent to an Ascon, we have there the whole inner surface deprived of flagellated, and covered with pavement, cells. This is the difference between a Sycon and a colony of

[1] *Loc. cit.*, pp. 159, 160.

Ascones, and this is just the circumstance to which Vosmaer does not pay sufficient attention. "And an Olynthus," says Dr. Vosmaer further, "is nothing but a primitive Ascon." I understand the Olynthus otherwise. The Olynthus is a neutral being, and the Ascon one of its modifications, the Sycon another. An Olynthus may increase longitudinally only, without lateral growth, and in that case it will give origin to an Ascon, the most marked peculiarity of which, in comparison with all other sponges, consists in the slight development of its mesoderm, in other words, in very marked thinness of its walls. An Olynthus may also grow in all directions, in length as well as laterally. This lateral growth would consequently necessitate a larger increase of the mesoderm. Its strong development is not a matter of absolute necessity: a good number of Calcarea (Ascones), though almost devoid of mesoderm, prosper notwithstanding. The mesoderm is, however, a very important constituent part of the organisation of the sponge, for in it the skeleton and generative elements are situated, and it is evident that under certain circumstances its strong development might have proved to be of great importance—the majority of sponges are rich in mesoderm, and we know that its early development is one of the chief characters differentiating the Porifera from the Cœlenterata proper. Its strong growth, however, according to the law of correlation of the organs and with respect to Olynthus, cannot remain without consequence. Let us now suppose—and this supposition will be, if not proved in the scientific sense of the word, at least shown to be probable—let us suppose that the cells which are charged with the feeding of the sponge are chiefly pavement-cells, indifferently of ecto- or endodermic origin, and not flagellated cells. The lateral growth in the Olynthus must in any case have a limit, for, its walls becoming thicker, the outer surface covered with pavement-cells must, sooner or later, according to geometrical laws, become too small to feed the whole. If this limit be passed, a change in the organisation becomes necessary, the surface covered with pavement-cells must, in some way or other, grow larger. In order to form a Sycon, pocket-like invaginations are formed in the Olynthus; we have seen, however, that these invaginations, viz., radial tubes, bring about an absolute not comparative enlarging of the outer as well as of the inner surface, and that, alone, they would be of no use; every thin-walled radial tube, like an independent Ascon, would be able to take care of its own feeding, but would be of no service to the comparatively thick-walled central tube representing the supporting apparatus of the whole. We should therefore expect here a corresponding accommodation, and this accommodation I see in the substitution of pavement-cells for the flagellated cells covering its inner surface in the embryonal stage of development, the radial tubes taking upon themselves alone the function of the circulation of the water. To sum up, I formulate my conclusions in the following manner:—

The Ascones and the Sycones are two fundamentally different modifications of the Olynthus, their chief distinction consisting in the unequal development of the mesoderm,

its larger distribution in the Sycon having brought about the differentiation of the endodermic elements into flagellated and pavement-cells.

All this was stated on the supposition that it is principally pavement-cells which take in the nutritious particles. We have now to search into the corresponding physiological statements. The question has its own literature, but the statements of Lieberkühn,[1] Hæckel,[2] Carter,[3] Keller,[4] Metschnikoff,[5] Vosmaer,[6] and Krukenberg[7] upon the subject are so very conflicting, that it must be regarded as very fortunate that science has recently been enriched by the new detailed observations of an investigator conscious of these contradictions. I speak of the beautifully illustrated memoir of Dr. v. Lendenfeld on the Aplysinidæ of the South Sea.[8] His physiological statements are the result of numerous, and, as it seems, very carefully-made experiments. It is the more to be regretted that v. Lendenfeld was not quite impartial in the execution of the task. I do not mean to say that the experimenter was under the influence of the ideas on the morphology of the Sponge upheld by the late Prof. Balfour, but I think that had Dr. v. Lendenfeld begun his experiments in order to answer the question "Which cellular elements in the Sponges do carry on the nutritious process?" instead of "Are these elements of endodermic or ectodermic origin (*loc. cit.*, p. 251)?" he would have come to rather different conclusions. Dr. v. Lendenfeld suggests that—(1) all free surfaces of the Sponge are able to take in the food—a very important observation, for it reconciles in some measure the contradictory statements of former observers; and that (2) while the particles of carmine having entered the pavement-cells covering the subdermal cavities do pass into amœboid cells of the mesoderm in order to make their way from the superior part of the Sponge to the zone of the flagellated chambers, and to be afterwards pushed out by the flagellated cells, the flagellated cells neither retain the particles of carmine taken in from the water, nor deliver them to the mesodermic cells, but throw them out shortly after having imbibed them.

Dr. v. Lendenfeld tells us further, that the particles of carmine, taken in by the pavement-cells of the subdermal cavities, having been finally pushed out by the flagellated cells, appear altered in their form, presenting now rounded not sharp edges as they did before; and that this is not the case with the particles taken up by the flagellated cells. If now Dr. v. Lendenfeld comes to the conclusion that the flagellated cells are excretory organs of the sponge, I find this conclusion very natural and even plausible, although not quite beyond the reach of doubt, his experiments having been made with carmine and not with really nutritious material. At all events, however, I agree with him that the flagellated cells are not to be regarded as special organs concerned in the feeding of the sponge. For against this there are objections from a, so to speak, mechanical point of view.

[1] *Archiv f. Anat. u. Physiol.*, p. 385, 1857.
[2] Kalkschwämme, Bd. i. p. 372.
[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 374, 1879.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxx. p. 570, 1878.
[5] *Ibid.*, Bd. xxxii. p. 371, 1879.
[6] Voorloopig berigt, &c., p. 5.
[7] *Vergleichend-physiologische Studien*, Bd. i. p. 65, 1879.
[8] *Zeitschr. f. wiss. Zool.*, Bd. xxxviii. p. 234, 1883.

Let us imagine a sponge (*e.g.*, a Sycon) under its usual conditions. The cilia of the flagellated cells are in movement, and the water enters through the pores into the radial tubes in order to make its way to the osculum; let us pursue the direction taken by a particle coming through the pores into the Sponge. If such a particle, having entered the radial tube, be constrained to follow the most rapid course of the water, viz., that in the middle of the tube, it is evident that it will reach the gastric opening of the tube without any contact with the flagellated cells; now, if precipitated by the whirlpool occasioned by the cilium of the next flagellated cell in an oblique direction towards the wall of the tube, the possibility is not excluded that, following this direction, it will reach the comparatively slow current of the water close to the flagellated cells, and be taken in by one of them; but, even though this may happen, such an issue cannot occur very often, for the comparatively slow flowing of the water near the surface of the wall is of a somewhat vortex-like nature, the waves caused by the cilia being, even at this spot, more or less felt; and if, on the other hand, the particle be lifted by the wave of the cilium into its superior part, the particle, passed on from one wave to another, will make its way by fits and starts, but still, like those following the current in the middle of the radial tube, without any contact with the flagellated cells. There are in the radial tube two kinds of motions of the water, the rapid and direct current in the middle, and the vortex-like near its walls, and both are unfit for the purpose of bringing the particles in contact with the flagellated cells. Therefore, though not denying that the flagellated cells may occasionally take in nutritious particles, I cannot admit that this is their chief function—they have besides another task of a motor character.

I find it, however, very doubtful whether the nutritive function must be ascribed, as Dr. v. Lendenfeld does, to the ectodermic pavement-cells exclusively. He states that the flagellated cells take in the particles of carmine in order to push them out forthwith; he states also that the endodermic pavement-cells take in the particles of carmine too, but there is in the paper no suggestion that these latter particles would be pushed out in their turn; and if we reflect upon the fact that (1), from the mechanical point of view, the ecto- and endodermic pavement-cells are exactly under the same conditions, the water advancing calmly and slowly along the outer surface of the sponge, and forming no whirlpools between the gastric openings, these latter being of smaller diameters than those of the radial tubes; that (2) mesodermic amœboid cells, sparsely scattered near the flagellated chambers, are quite as numerous near the layer of pavement-cells of the exhalent canal system as near the subdermal cavities; that (3) the ecto- and endodermic pavement-cells are histologically (at least in Calcarea) quite equivalent; and that (4) there is no room for the supposition that the nutritious particles having entered the sponge organism could all be absorbed by the pavement-cells of the subdermal cavities; if we reflect upon all this, I think we must come to the conclusion that there are no reasons for ascribing different functions to the ectodermic and endodermic pavement-cells.

Now, so far as concerns the histological identity of both these kinds of elements, this identity finds expression even in the modifications which the pavement-cells undergo under certain circumstances. Usually very thin, and provided with fine-grained protoplasm, the pavement-cells appear sometimes far thicker and their granules much larger and more numerous. I have often observed such modifications, and nowhere better than in *Leucetta vera*, n. sp. (Pl. VIII. fig. 8). Sometimes these coarse-grained cells form the epithelium either of the exhalent or of the inhalent canals; in most cases, however, both that of the exhalent and that of the inhalent canals indiscriminately. Since I always found in the same sponge surfaces covered with common pavement-cells, in addition to the surfaces covered with coarse-grained cells, the supposition that the large granules present a constant constituent part of the cells, characteristic of the species, is not admissible. On the other hand, the character of the modification in the cells in question proves that it stands in immediate connection with the nutritive process, and there being, as I remarked before, no distinction in this respect between ecto- and endodermic pavement-cells, I see in this a new reason for ascribing the nutritive function to the pavement-cells both of endo- and ectodermic origin. I must add that the expression "nutritive function" has been used by me with the meaning "reception of the food," and not inclusive of digestion, all cellular elements of the sponge-organism being probably capable of this latter function. A corollary of the highest importance deduced from the foregoing remarks has already found its application.

Let us now turn from the Sycones to the phylogenetic affinities of the Leucones. There are amongst the Sycones described by Prof. Hæckel a good number of forms which, compared with *Sycetta primitiva*, *Sycandra raphanus*, &c., must be regarded as considerably modified Sycones, the differences pervading the whole plan of their organisation. I speak of the type represented in the Monograph by the species *Sycetta stauridia*, *Sycilla urna*, *Sycilla chrysalis*, *Sycilla cylindrus*, *Sycilla cyathiscus*, *Sycaltis glacialis*, *Sycaltis testipara*, *Sycaltis ovipara*, and *Syculmis synapta*. Every impartial investigator, when comparing, for instance, *Sycandra raphanus* with *Sycilla chrysalis*, would refer them to two distinct genera. "In die bis jetzt bekannten Sycortisformen passt *Sycortis sycilloïdes* nicht gut herein," writes Schuffner, describing a calcareous Sponge of the type of *Sycilla chrysalis*, "es schliesst sich dieselbe in ihrer Zusammensetzung und in dem Bau des Skelets der Radialtuben vielmehr an eine Sycilla oder Sycaltis-form an."[1] This is my opinion too.

Prof. Hæckel, constant to his principles of classification by the spicules, assigns no systematic significance to these differences of organisation, yet they did not escape him. So he distinguished[2] two types of radial tubes, characterising them by differences in the

[1] "*Sycortis sycilloïdes* does not seem to be appropriately placed along with the hitherto known forms of *Sycortis*. In its composition and inthe structure of the skeleton of its radial tubes it is more nearly allied to *Sycilla* or *Sycaltis*." Beschreibung einiger neuer Kalkschwämme, *Jenaische Zeitschr.*, Bd. xi. p. 422, 1877.

[2] Kalkschwämme, Bd. i. p. 319.

disposition of their spicules. In one case—Hæckel's "articulated" ("gegliedertes") tubar skeleton—the spicules, usually triradiate, lie in the walls of the radial tubes in many rows, one row behind the other, their basal ray being directed towards the dermal extremity of the tube, whilst the lateral rays diverge towards its gastric ostium; in the second case—Hæckel's "non-articulated" ("ungegliedertes") tubar skeleton—there are no transverse palisades, formed by the lateral rays of the triradiate or quadriradiate spicules (*Sycandra arctica*, H.); moreover, there are no special tubar spicules, but only tubar rays of the dermal or subdermal and subgastric triradiate or quadriradiate spicules. For instance, in *Sycilla cyathiscus* (Kalkschwämme, Bd. iii., pl. xliii. fig. 9) the subgastric quadriradiate spicules lying with their facial rays in the gastric wall, parallel to its inner surface, send their apical rays centrifugally towards the dermal surface, and these apical rays joining the centripetally directed apical rays of the corresponding subdermal quadriradiate spicules form the supporting skeleton for the radial tubes. If the question be asked, which Sycones must be considered to be more primitive, these with articulated tubar skeleton or those with unarticulated one, there can be but one answer:—these with the articulated.

The embryology of the Sycones of the type of *Sycilla cyathiscus* remains certainly still to be explored, but there are in the development of the Sycones of the second type no phases which would lead us to assume that the non-articulated form of tubar skeleton might be a primary one. On the contrary, the ontogeny of *Sycandra raphanus* shows obviously that Prof. Hæckel's conjecture that *Sycetta primitiva*, *Sycaltis conifera*, and, generally speaking, the Sycones with free radial tubes are the most primitive forms of the family, is quite in harmony with the facts of the case. Now, the tubar skeleton in the forms with free radial tubes is always articulated, and, as it is evident that a non-articulated tubar skeleton could not have been developed before the formation of a cortex which was produced by the fusion of the distal ends of the radial tubes, there can be no doubt that the articulated tubar skeleton has brought about the possibility of the formation of the non-articulated, and not *vice versa*. For the rest, this can be proved by means of anatomical comparison, there being amongst the Sycones hitherto described many intermediate stages connecting the extreme forms of these two different types. From *Sycetta primitiva*, through *Sycandra coronata* and *Sycandra raphanus*, we come to *Sycandra arctica*, the radial tubes of which, grown together in their superior part, give rise to a structure closely resembling a cortex, and it is only the form and disposition of the spicules of its skeleton which force us to regard the outer surface of this sponge as still lacking an independent cortical layer. In *Sycandra compressa*, *Sycortis lævigata*, *Sycetta strobilus*, &c., we already find specimens with a perfectly distinct cortical layer, provided with a quite independent skeleton. This latter consists certainly of spicules homologous with those in the distal end of the radial tubes of, for instance, *Sycandra arctica*, but so much modified, and having adopted such a

different disposition, that one would take them for an entirely new formation. And if in *Sycandra compressa* the individuality of the radial tubes still finds its expression in the disposition of the accrate spicules, the radial tubes in *Sycortis lævigata* or *Sycetta cupula*, enclosed between two distinctly parallel layers, that of the cortex and that of the gastric surface, show as yet not the slightest trace of any independence. The tubar skeleton of these latter sponges is still articulated; but, owing to the presence of an independent cortex, its transformation into the non-articulated, under certain conditions, may be very easily imagined.

Let us admit that some of the dermal triradiate spicules, for instance, in *Sycortis lævigata*, develop a fourth apical ray—this ray will have a centripetal direction; and again let us imagine that the subgastric triradiate spicules grow larger, so that their centrifugally directed basal ray approaches more or less nearly the dermal extremity of the tube; it is evident that the tubes thereby receive a new system of supporting spicules, which render the former one—the articulated skeleton—superfluous. There are not always present, however, quadriradiate spicules, which, lying with their facial rays in the plane of the dermal surface, support with their apical rays the radial tubes. Such spicules may be triradiate also, as is the case with *Sycaltis glacialis* (Kalkschwämme, Bd. iii., pl. xlv. fig. 5), *Amphoriscus poculum*, n. sp. (Pl. IV. fig. 4), &c.

Now I have found—and this is a very interesting fact—that in *Amphoriscus poculum* and in *Amphoriscus flamma* (Pl. V. fig. 3*b*), these subdermal triradiate spicules have precisely the same form as those of the cortex, the former differing from the latter only in the fact that one of their rays exceeds the others in length. According to the position of these subdermal triradiate spicules, their longer ray being directed centripetally, and their two remaining rays diverging towards the dermal surface, one would say that their longer ray is the basal. This, however, is not admissible. Its length being variable, there are in the species just named many subdermal triradiate spicules, which, if removed from the soft parts of the sponge, would certainly be confounded with the spicules of the cortex, and, as their position also is not quite constant, their rays lying sometimes in a plane forming an acute or an obtuse angle with the longitudinal axis of the sponge, the only deduction possible is that these subdermal triradiate spicules are nothing but spicules of the cortex, modified with respect both to their form and to their position, and that, consequently, their longer centripetally directed ray is one of the lateral rays. This conclusion is of great moment, for, in connection with other anatomical and embryological facts, before communicated, it presents a conclusive proof that the Sycones with non-articulated tubar skeleton owe their origin to Sycones whose tubar skeleton was articulated. The transformation of the first type into that characteristic of the family Leucones can now be followed step by step.

There are amongst the Sycones which are characterised by a non-articulated tubar skeleton, forms in which the radial tubes, instead of ending each with its own gastric

ostium meet by threes, by fours, and even more around the same opening. This is the case, for instance, in *Amphoriscus elongatus*, n. sp., and, if we compare the corresponding picture (Pl. IV. fig. 5) with that showing the inner organisation of my *Leucilla connexiva* (Pl. VI. fig. 1*a*), the way in which the Leucones have been developed from the Sycones will be quite clear. What is to be regarded as an exceptional arrangement in a Sycon becomes the rule in a Leucon. The invagination of the gastric surface, shallow in the Sycon, becomes deep in the Leucon; the irregularities in the disposition of some of the subgastric and subdermal spicules also arise gradually, and it is not every one of these spicules which retains its place between two neighbouring radial tubes; this, moreover becomes physiologically unnecessary, for a diminution in the size of the radial tubes follows their rising towards the dermal surface. The invaginated part of the gastric cavity, presenting in its simplest form a cone without secondary lateral sacs, may produce branches in its own turn. We find this condition depicted in Pl. VI. fig. 2*a*.

The radial tubes—here more correctly called flagellated chambers—although still of cylindrical form are short and comparatively small, and though the subdermal quadriradiate and the subgastric triradiate spicules preserve their former disposition, there are to be found in the parenchyma spicules scattered without any evident order. Now the ramifying of the invaginated parts of the gastric surface may go further and further; hand in hand with this the flagellated chambers become smaller; their form also undergoes a modification; elongated in the preceding cases, they now grow more or less round. The intercanals, whose function is to provide the flagellated chambers with water, following the modification in the disposition of these latter, already somewhat irregular in the Sycones with non-articulated tubar skeleton, ramify more and more; it becomes quite impossible to find any order in the disposition of the spicules in the parenchyma; and if we examine Pl. VI. fig. 3*a*, which gives a true idea of the typical organisation of the Leucones, we shall find in the species to which the illustration refers (*Leuconia multiformis*, n. sp.) but one trace of its origin from the Sycones, viz., the subgastric triradiate spicules, which send their basal ray towards the cortex, their curved lateral rays lying in the plane of the gastric surface. These triradiate spicules being in most cases very thin in comparison with the stout triradiate ones of the parenchyma, no physiological signification can be assigned to them, and I think there can be no other explanation of their presence except that of a phylogenetic character. In *Leuconia typica*, n. sp., presenting a form closely allied to *Leuconia multiformis*, these interesting subgastric triradiate spicules are no longer to be found, and the spicules of the cortex, as well as those of the gastric surface, are the only constituent parts of the skeleton which follow a fixed law in their disposition. I do not speak of the quadriradiate spicules accompanying in certain species the exhalent canals in all their windings, for they are exact homologues of the quadriradiate spicules of the gastric surface. In some cases, for instance in *Pericharax*

carteri, n. sp., or in *Leucetta hæckeliana* (Pl. VIII. fig. 1), these quadriradiate spicules being present in the exhalent and absent in the inhalent canals, both the systems of the canals can be readily distinguished from one another, and I am inclined to see in this fact an anatomical confirmation of the conceptions of Prof. F. E. Schulze,[1] according to whom the pavement-cells of the inhalent canal system are of ectodermic, those of the exhalent of endodermic, origin.

I have now to make a summary of my conclusions; I formulate them as follows:—

The Leucones are nothing but modified Sycones with non-articulated tubar skeleton; their flagellated chambers are complete homologues of the radial tubes; their exhalent canals owe their origin to the invaginations of the inner cavity, and their inhalent canals are to be regarded as homologous with the intercanals of the Sycones.

There are no further complications of the canal system in the group Leucones which require particular explanation; and now—since I have completed its definition, including its development, and since some corrections concerning Hæckel's statements as to the canal system of the Sycones have been made, as there is nothing to be added to Prof. Hæckel's description of this system in the Ascones—I can return to the important question put some pages before, whether the properties of the canal system can be really used as characters for the definition of families. It is quite evident that this question must be answered in the affirmative. For it is the canal system which is, in Calcarea, the principal vital organ, and it is the type upon which the mutual disposition of the component parts of the second important organ, the skeleton, as well as the greater or smaller development of the connective tissue, depends. And there are in the Calcarea, beside the form and the quality of the spicules and the external form of the animals, both of which are very variable, no other characters of systematic value. Most of them—some Ascones (Keller,[2] Barrois[3]), and very probably *all* Sycones and Leucones—have the same kind of development, characterised by the well-known Amphiblastula; and although the species *Ascetta blanca*, *Ascetta primordialis*, *Ascetta clathrus*, and probably some other Ascones, have a larva of a different type, this difference, even in the eyes of a professional embryologist, is of no greater value than to prompt him to the following remark:—"Wenn dies (development of some species of *Ascandra* like that of *Sycandra* and *Leucandra*,) sich durch unmittelbare Beobachtung bestätigen sollte, so würde das nur zeigen, dass zwischen der Gattung *Leucandra* und *Sycandra* eine nähere Verwandschaft als zwischen *Ascandra* und *Ascetta* besteht";[4] not that *Leucandra*, *Sycandra*, and *Ascandra* ought to be put together in order to oppose them systematically to *Ascetta*; and even this opinion, the embryological facts being of a very precarious nature, can still

[1] Die Plakiniden, *Zeitschr. f. wiss. Zool.*, Bd. xxxiv. p. 437, 1880.

[2] Ueber d. Anat. u. Entwick. einiger Spongien, 1876, p. 32.

[3] Embryologie, &c., p. 35.

[4] Even if this (development, &c.) should be confirmed by direct observation, it would merely show that between the genera *Leucandra* and *Sycandra* there is a nearer relationship than between *Ascandra* and *Ascetta*. E. Metschnikoff, *Zeitschr. f. wiss. Zool.*, Bd. xxxii. p. 370, 1879.

be disputed. We come, therefore, in accordance with Prof. Hæckel, to the conclusion that to the properties of the canal system the greatest systematic value must be assigned. It is, however, not to be forgotten that in different cases this value is not equal.

The canal system of the Leucones is nothing but a simple modification of that of the Sycones, and a modification in the direction of a further development. Not so with the Ascones as compared with the Sycones. As I endeavoured to show when discussing the question of the affinities of the Calcarea amongst themselves, the canal systems of both these families are products of quite different modes of development, that of the Ascones presenting a modification in one direction, that of the Sycones in another; and if we now give expression to this phylogenetic difference, the division of the Class Calcarea into two Orders becomes necessary.

But it is high time to state the arguments which lead me to regard the Calcarea as a Class and not as a Sub-class or Order. Of course, the systematic position of the group Porifera in the animal kingdom is at present ambiguous. It is, however, clear that, if the group is to be regarded as an independent type, this type is not to be opposed to all the other types combined, as Balfour has proposed, and, on the other hand, if the sponges are to be united with Cœlenterata, this could take place only if they were erected into a separate sub-type within this type. As far as the well-known hypothesis of the late Prof. Balfour[1] is concerned, I refer the reader to a detailed critique in Mr. Marshall's[2] paper "On the ontogeny of *Reniera filigrana*." What I may have to add on my own part will not occupy more than a few words. Balfour sees in the Amphiblastula a colony of Infusoria, and founds his further conclusions on the fact that the cells in the larva which become invaginated are not coarse-grained and dark-coloured, but transparent monociliated cells of cylindrical form (E. Metschnikoff,[3] F. E. Schulze[4]). It is, however, questionable whether the Amphiblastula is really a larva of primary characters.

There are Calcarea whose development is marked out by a larva of quite different type (Parenchymula), and Metschnikoff's Vergleichend-embryologishe Studien[5] make it very probable—if not certain—that it is indeed Parenchymula that shows the most primitive features of a Metazoon; and as the Blastula of the Calcarea in question presents a vesicle whose cellular elements do not differ one from another, it is evident that the chief character of the Amphiblastula is of a secondary nature. Its further development, viz., the invagination of the clear cylindrical cells, is indeed very striking, but this phenomenon is also common to the development of some other animals (*Lumbricus*, Kowalevsky,[6] *Oxyuris*, Natanson[7]), and this latter circumstance renders its value for any phylogenetic speculations still more dubious.

[1] *Quart. Journ. Micr. Sci.*, vol. xix. p. 103, 1879.
[2] *Zeitschr. f. wiss. Zool.*, Bd. xxxvii. p. 240, 1882.
[3] *Ibid.*, Bd. xxiv. p. 1, 1874.
[4] *Ibid.*, Bd. xxxi. p. 262, 1878.
[5] *Ibid.*, Bd. xxxvi. p. 433, 1881; Bd. xxxvii. p. 286, 1882.
[6] *Mém. Acad. St. Petersb.*, sér. 7, t. xvi. Mém. 12, p. 22, 1871.
[7] *Trans. Fifth Meeting of Naturalists in Warsaw*, Sect. of Zool. and Comp. Anat. (Russ.).

The Sponges also are not to be placed among the Cœlenterata as a class, as suggested by Ganin.[1] The peculiarities of their canal system, the early development of the mesoderm, the circumstance that it is just the mesoderm which in them gives origin to the generative products, and finally, the absence of cnidoblasta and nervous elements, these latter having been recently observed in the Hydroida also (Jickeli)[2]; all these differences taken together, though perhaps not justifying the establishment of a new type, are yet important enough to entitle the Sponges to occupy an independent subdivision of the Cœlenterata in the position of a sub-type. That within this sub-type, the Calcarea, constituting a quite isolated group, are to be opposed as an independent Class to all other Sponges is so evident that I hope no further arguments in favour of the position will be deemed necessary, and this Class I propose, in accordance with my foregoing statements, to divide into two Orders :—

Homocœla, including the single Family of Asconidæ (Ascones), and

Heterocœla, including the Families of Syconidæ (Sycones), Leuconidæ (Leucones), and Teichonidæ (Teichonia, Teichonellidæ).

The necessity for the establishment of this third Family, the Teichonidæ, having been urged some years ago by Mr. Carter,[3] who described two calcareous sponges which differ from all the Calcarea hitherto known, by one peculiarity of such vital importance that the establishment of a new Family was really the only issue. This peculiarity consists in the differentiation of the outer surface of the sponge into two quite different parts,—that bearing oscula and that bearing pores,—and I am the more disposed to agree with Mr. Carter, as I found amongst the Challenger Calcarea some specimens which are constant to the main character differentiating the genus *Teichonella*, C., from other Calcarea, although they differ from it in their general shape—which in a form so highly organised is not without significance—and in their spiculation so much that I really cannot place them as a third species in that genus, but must create a new one for their reception.

I have now done with Orders and Families; I return to the genera. It was stated that the properties of the constituent parts of the skeleton as to whether they be composed of triradiate, quadriradiate, or acerate spicules are by no means to be utilised as generic characters; and hence that the seven genera established by Prof. Hæckel in each of his three Families are not natural, but artificial.

How then is a natural classification to be devised? The answer is easy :—by the consideration of all the organs of the animal in their mutual correlation. Hæckel has pointed out the high systematic significance of the canal system, and he clearly understood, moreover, that the disposition of the spicules depends upon its modifications, and that the disposition of the spicules in its own turn influences their form. He dedicates to these questions a considerable number of pages (*loc. cit.*, Bd. i. pp.

[1] Contributions to the Anatomy and Embryology of the Sponges, Warsaw, 1879, p. 83 (Russ.).

[2] *Morph. Jahrb.*, Bd. viii. p. 373; *Ibid.*, p. 580, 1882.

[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 35, 1878.

296–327), and, agreeing with him thoroughly upon the matter, I see no reason to repeat here what has already been quite sufficiently discussed. I refer the reader to the passages in question in the Monograph, and can only express my astonishment that Hæckel having made out the existence of the correlations above mentioned in such a brilliant manner, did not give them any application in his system.

It was, however, the right way, and if the following out of these principles amount to nothing with reference to the Asconidæ, it only proves, either that the Ascones are not to be divided into many genera at all, or that our knowledge of this group is insufficient. I think both suppositions have some truth in them. At all events, there is at present no possibility of giving a detailed system of this Order. The exterior shape is in this group—perhaps with exception of the forms provided with solid peduncle—really without any significance, at least it is quite unfit for the establishment of genera. The *Wagnerella* of Mereschkowsky,[1] proved to be a Protozoon[2], and, except the still doubtful *Mœbiusspongia parasitica*, Duncan,[3] there are in the Family only two groups which admit of a generic distinction, the distinction consisting in the differences of the embryonic development, characterised in some cases by Parenchymula, in others by Amphiblastula. Unfortunately the embryology of most of the Asconidæ is still surrounded by the mist of uncertainty, and it is only to five species (*Ascetta primordialis*, *Ascetta blanca*, *Ascetta clathrus*, *Ascandra lieberkühnii*, and *Ascandra contorta*,) that the foregoing remark can be applied. Therefore, till zoology shall have been enriched by more extended investigations upon this matter, I propose to unite provisionally all the Asconidæ under the same generic name, and, following the law of priority, I propose the name—

Leucosolenia, Bowerbank[4].

The necessity for such a temporary measure is by no means satisfactory, but still it is always better to confess frankly that our knowledge is imperfect, and that there remains much still to be done, than to allow ourselves to be led astray by the assurance, however flattering, that everything is already completed and the question exhausted.

We have every reason to consider ourselves much more advanced with respect to the Heterocœla. There are to be found characters of undoubted generic significance, *i.e.*, characters of sufficient constancy, and allowing numerous modifications, either in the direction of a further development, or in the direction of different variations. The nature of the spicules proclaimed by Prof. Hæckel as furnishing good generic characters, satisfies only the second condition, and therefore they are unfit for generic distinctions, apart from the consideration that in a group of such a low organisation as Calcarea a generic character

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. i. p. 70, 1878.
[2] Paul Mayer, *Zool. Anz.*, No. 32, p. 357, 1879.
[3] *Journ. Roy. Micr. Soc.*, vol. iii. p. 377, 1880.
[4] *Phil. Trans.*, London, vol. clii. p. 1093, 1862.

cannot be expressed by the property of a single organ, but must be of consequence for the whole structure of the animal. I hope the genera I am about to characterise will be found to be more "natural," and if my diagnoses be not quite sharp and have sometimes rather a conditional character, I must confess it is just in this that I see a reason for hoping that my genera are not artificial. Nature does not conform to our definitions, and if each of two genera, apparently closely allied one to the other, admit of a sharp, distinct diagnosis, it proves nothing but that the intermediate connecting forms do not now exist, but have died out.

In the Family of Syconidæ I distinguish the following six genera:—

1. *Sycon*, Risso[1] (sensu mutato).

Syconidæ with articulated tubar skeleton, with radial tubes either quite free or, if grown together, in such a manner that the individuality of every tube, owing to the absence of any independent cortex, may be easily discerned.

A detailed definition of this genus, as well as of the genera *Grantia* and *Amphoriscus*, has already been given. I group in it the following species:[2]—

Sycon primitivum, H.
sagittiferum, H.
coniferum, H.
ciliatum, F.
coronatum, E.S.
lingua, H.
quadrangulatum, S.
capillosum, S.
ampulla, H.
raphanus, S.
setosum, S.
villosum, H.
ramosum, H.

Sycon arcticum, H.
quadratum, Sch.
boreale, Sch.
schmidtii, H.
tabulatum, Sch.
elegans, Bk.
humboldtii, L.
barbadense, Sch.
arboreum, H.
gelatinosum, B.
utriculus, S.
hystrix, H.

[1] Hist. Nat. de l'Eur. mérid., vol. v. p. 368.

[2] B. = Blainville, Bk. = Bowerbank, C. = Carter, G. = Gray, E.S. = Ellis and Solander, F. = Fabricius, H. = Hæckel, J. = Johnston, L. = Lieberkühn, MM. = Miklucho-Maclay, R. = Ridley, S. = O. Schmidt, Sch. = Schuffner; n. sp. after the name of a species indicates, of course, that it is new; a ?, the doubt of the author as to whether the species is really to be placed in the genus.

2. *Grantia*, Fleming[1] (sensu mutato).

Syconidæ with articulated tubar skeleton, with radial tubes which have lost every trace of individuality, owing to the formation of a cortex, which is quite independent, however thin, its skeleton consisting mainly of triradiate spicules.

I include in this genus the following species :—

Grantia strobilus, H.	*Grantia perforata*, H.
cupula, H.	*compressa*, F.
lævigata, H.	*tuberosa*, n. sp.

3. *Ute*, O. Schmidt[2] (sensu mutato).

Syconidæ, the skeleton of whose strongly developed cortex consists principally of large acerate spicules, lying in several layers parallel to the outer surface.

There are at present only two forms which belong to this genus :—

Ute glabra, S.	*Ute argentea*, n. sp.

The main character distinguishing these two species is found in the properties of the tubar skeleton; in one case it is articulated, in the other non-articulated. This character is used by me with reference to the genera *Grantia* and *Amphoriscus* as a generic distinction, and of course it is possible that *Ute argentea* stands to the genus *Amphoriscus* in the same relation as *Ute glabra* to the genus *Grantia;* but so long as the embryology of *Ute argentea* is not known, there being no intermediate stages to decide the question, both the species must be united in one special genus since their main character so sharply differentiates them from all other Syconidæ.

4. *Heteropegma*,[3] n. gen.

Syconidæ with articulated tubar skeleton, the skeleton of whose strongly developed cortex, consisting of triradiate and quadriradiate spicules, is quite different from that of the parenchyma with respect to their size.

The tubar skeleton of this genus being articulated, it cannot be denied that the differences dividing *Heteropegma* from *Grantia* are quantitative rather than qualitative in nature. Yet the distinctions are great enough, and I am still more inclined to regard

[1] Hist. of Brit. Anim., p. 524, 1824.

[2] Spong. d. adriat. Meeres, Suppl. 1, p. 23, 1864.

[3] From ἕτερος—different, and πῆγμα—framework, skeleton.

Heteropegma as an independent genus, since it seems to play in the Family of Syconidæ the same part as *Leucetta* (s.m.) amongst the Leuconidæ, and this latter genus now contains four very good species. The agreement in the plan of organisation of both these genera is striking, and at first sight it would appear very likely that the genera *Leucetta* and *Heteropegma* form an independent branch in the genealogical tree of the Heterocœla, and consequently ought to be regarded as representatives of a new family. Still, in order to render this hypothesis plausible, it would be necessary—in view of the peculiarities of the internal organisation of *Heteropegma nodus gordii* (Pl. IV. fig. 1*a*)—to prove that the canal system of *Leucetta* has been developed from that of *Heteropegma* not by invagination of the inner surface between the radial tubes, but by the further ramification of the radial tubes themselves. Of course the possibility of such a transformation is not excluded; at any rate both are at present to be distributed in different families, the more so as there exists a form (*Leucetta imperfecta*, n. sp.) which on valid grounds can be regarded as a connecting link between the genera *Leucetta* and *Leuconia*.

The genus includes provisionally but one species:—

Heteropegma nodus gordii, n. sp.

5. *Amphoriscus*, Hæckel[1] (sensu mutato)

Syconidæ with non-articulated tubar skeleton, the supporting spicules of whose comparatively thin cortex are either triradiate or quadriradiate, or both triradiate and quadriradiate associated together.

I include in this genus the following species:—

Amphoriscus stauridia, H.
urna, H.
cyathiscus, H.
cylindrus, H.
chrysalis, S.
glacialis, H.
testiparus, H.

Amphoriscus oviparus, H.
synapta, H.
sycilloides, Sch.
(?) *atlanticus*, R.
poculum, n. sp.
elongatus, n. sp.
flamma, n. sp.

With regard to the systematic position of *Sycyssa huxleyi*, characterised by Hæckel amongst others also as having a non-articulated tubar skeleton, one can frame only conjectures. As described by Prof. Hæckel,[1] this very strange form stands quite isolated.

[1] Prodromus, p. 238.

6. *Anamixilla*,[2] n. gen.

Syconidæ without any special tubar skeleton, the supporting spicules of the parenchyma disposed in it like those in the Leuconidæ; in most cases, however, more or less parallel to the outer surface.

A certain analogy exists between *Anamixilla* and *Heteropegma*, and this analogy consists in the possession of a kind of spiculation which does not influence the form of the radial tubes. The tubar spicules of *Heteropegma* are too minute for it; the tubes of *Anamixilla* have no special skeleton at all, the spicules of their parenchyma showing an irregular "leuconoid" disposition. And, accordingly, the form of the radial tubes in both the cases is inconstant, they are of irregular outlines, may take an oblique course, and show an inclination to ramify.

The genus *Anamixilla* is hitherto represented by a single species :—

Anamixilla torresi, n. sp.

This species must undoubtedly be regarded as the representative of a new genus, for its organisation contains a new principle, and it is more than probable that there will be found Calcarea adhering to this principle, but presenting different variations in regard to the form and quality of their spicules.

I let the genus *Anamixilla* follow the genus *Amphoriscus;* a close relationship between these two genera cannot certainly be proved, but may be considered as very plausible, owing to the presence in my *Anamixilla torresi* of the peculiar subgastric triradiate spicules, so characteristic and of so great importance for most forms of the genus *Amphoriscus*. In *Anamixilla torresi* these subgastric sagittal spicules, compared with the large triradiate spicules of the parenchyma, are evidently too small and slender to be of any important physiological significance, and therefore can be regarded, not without reason, as an index of the phylogenetic affinities of the genus.

In the Family Leuconidæ I distinguish the following genera:—

Leucilla, Hæckel[3] (sensu mutato).

Leuconidæ with flagellated chambers of an elongated, cylindrical form, recalling that of the radial tubes of the Syconidæ, with the skeleton of the parenchyma bearing some traces of a certain regularity in the arrangement of its constituent parts, owing to the disposition of the subgastric and subdermal spicules opposite to each other.

[1] Kalkschwämme, Bd. ii. p. 259.

[2] From ἀναμίξ, confusedly, pell-mell.

[3] Kalkschwämme, Bd. ii. p. 132.

The properties of this genus have already been discussed in such a detailed manner that no further explanatory remarks are necessary. I ascribe to the genus *Leucilla* the following species :—

Leucilla connexiva, n. sp.	*Leucilla capsula*, H.
uter, n. sp.	(?) *crustacea*, H.
amphora, H.	(?) *echinus*, H.

Leuconia, Bowerbank.[1]

Leuconidæ with the spicules of the parenchyma, irregularly disposed throughout and with flagellated chambers of more or less regularly rounded contour.

The connecting link between the genera *Leucilla* and *Leuconia* I see in *Leuconia multiformis*, n. sp., the relationship resting upon grounds quite analogous to those which induced me to associate my genus *Anamixilla* with the genus *Amphoriscus*. But if the phylogenetic affinities of some species of *Leuconia* are clear, this is by no means the case with respect to many other forms, which for want of detailed comparative investigations are to be temporarily referred to the same genus. Moreover, I feel certain that, in the course of time, my *Leuconia* will be subdivided at least into four, possibly even into more, quite independent genera. I say this with reference, for instance, to the species *Leuconia alcicornis*, G., *Leuconia elongata*, Sch., *Leuconia cataphracta*, H., which I am quite sure will be sooner or later elevated to be the representatives each of a special genus. The same will probably take place with respect to the species *Leuconia johnstonii*, C., *Leuconia stilifera*, S., *Leuconia saccharata*, H., *Leuconia ochotensis*, MM.; and, on the other hand, with regard to the species *Leuconia fistulosa*, Bk., *Leuconia pumila*, Bk., *Leuconia levis*, n. sp. At present, however, the realisation of these subdivisions would be scarcely season able; it will be well to await further and more detailed comparative investigations, and provisionally I group in the genus *Leuconia* all the Leuconidæ which do not belong either to the genus *Leucilla*, to the genus *Leucetta*, or to the genus *Pericharax*.

Leucetta, Hæckel[2] (sensu mutato).

Leuconidæ, the skeleton of whose strongly developed cortex is quite different from that of the parenchyma.

The peculiarities of this genus, which has an analogue amongst the Syconidæ in *Heteropegma*, consist in the possession of a strongly developed cortex and of two quite different skeletons, that of the cortical layer being characterised by large spicules, that of

[1] Brit. Spongiad., i. p. 164, 1864.

[2] Kalkschwämme, Bd. ii. p. 116.

the parenchyma by minute ones. These two characters are causally related to each other. A thick cortex with a strongly developed spiculation, presenting a solid support for the body of the Sponge, the parenchyma can extend itself on it like a crust, and the spicules of the parenchyma becoming unnecessary, grow small. I think that when, as for instance, in *Leucetta clathria*, H., the apical rays of the cortical quadriradiate spicules are strongly developed, these apical rays possess rather a defensive than supporting function; projecting from the inner surface their sharp ends present an armament protecting the inner cavity; and when such protection becomes useless, we see either that there are no quadriradiate spicules at all in the cortex (*Leucetta corticata*, H.), or very few, whose apical rays remain far short of the inner surface (*Leucetta hæckeliana*, n. sp.).

The genus is represented by five species, namely :—

Leucetta imperfecta, n. sp. | *Leucetta hæckeliana*, n. sp.
vera, n. sp. | *corticata*, H.
Leucetta clathria, H.

Two have been described by Hæckel, three were collected by the Challenger. I retain for the genus the name *Leucetta*, there being no doubt that the species described by Hæckel under the generic name of *Leucetta* prior to his *Leucetta corticata* all belong to the genus *Leuconia*.

Pericharax,[1] n. gen.

Leuconidæ with distinct subdermal cavities.

In vol. i. p. 237 of his Monograph, Prof. Hæckel states that the subdermal cavities (intermarginal cavities of Bowerbank) are of rare occurrence in the Calcarea, and that he met with them only in one case, namely, in his *Leucandra cucumis*. This is quite true; in most cases the inhalent canals in the same animal sometimes begin with a dermal dilatation, sometimes, on the contrary, they are narrow near the outer surface, and grow larger and broader in their centripetal course. *Leucandra cucumis* presents, however, an exception. Here, according to Hæckel, one can speak of real, well-marked subdermal cavities; they are all on an average of the same dimensions, of the same form, and even possess their own skeleton. The same I find in two specimens from Station 135 (Tristan da Cunha). In these forms the subdermal cavities, which are nothing but dilated dermal parts of the inhalent canals (intercanals), are not so strongly developed as in *Leucandra cucumis*, but are still quite distinct and also—at least in one specimen—

[1] From περί, around, and χάραξ, palisade.

possess their own skeleton, the spicules constituting their support being of quite a different form from all other spicules of the sponge. I think this peculiarity is important enough to be regarded as a generic character, and as there are in the Monograph of Prof. Hæckel nine Leuconidæ described under the name of *Leucandra* prior to our *Leucandra cucumis*, three of them being in addition quite new forms, I think it preferable to unite temporarily the forms with evident subdermal cavities under a new name. I propose the name *Pericharax*, till we receive more detailed information as to the systematic position of *Leucandra caminus*, H., *Leucandra lunulata*, H., and *Leucandra crambessa*, H.

The Family Teichonidæ consists at present of only two genera, of which the first is,—

Teichonella, Carter.[1]

It contains two species, *prolifera* and *labyrinthica*, and Mr. Carter characterises it as follows :—"Vallate or foliate, without cloaca. Vents numerous, confined to the margin or general on one side of the lamina only; naked." This definition, compared with that given by Bowerbank[2] to his genus *Leucogypsia*, renders it evident that the expression "without cloaca" is used by Mr. Carter in a somewhat different sense. The Australian specimen of my *Leucondra dura* (Pl. II. fig. 3) would have been referred by Bowerbank to the genus *Leucogypsia*. Like *Leucogypsia gossei*, Bwk., it possesses no evident cloaca; still it does not belong to the Teichonidæ,[3] the main character of this Family consisting in the differentiation of the outer surface into two planes, one bearing oscula, the other pores exclusively. But whether the oscula in Teichonidæ are homologous with the oscula of Hæckel or the oscula of Bowerbank, it is difficult to say; the question can be decided only by means of embryological observations. Amongst the Challenger Calcarea I have a specimen (*Leuconia typica*, var. *massa*), provided with a low and comparatively broad, calyciform inner cavity. It may be that the oscular plane of our Teichonidæ is homologous with the surface of this calyciform cavity, and is nothing but the gastric surface of a Syconid or Leuconid, modified with respect to its form and position. It may also be that the Teichonidæ are allied to the forms like my *Leuconia dura*, *i.e.*, that a Teichonid is, from a morphological point of view, a colony with dislocated oscula and pores. It must be noticed that, in view of F. E. Schulze's statements as to the ontogeny of *Sycandra raphanus*, this latter supposition is more plausible. At any rate the peculiarity in question is to be considered as a family character, the more so as there is no possibility of putting my *Eilhardia* in the genus *Teichonella* as a species, the differences in the spiculation and exterior form being too considerable. The diagnosis of this genus will be as follows :—

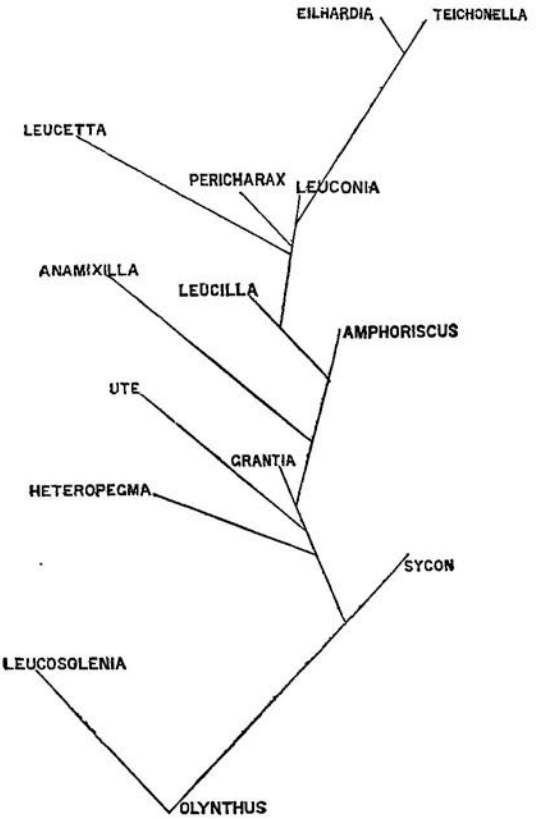
[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 39, 1878.

[2] Brit. Spongiad., vol. i. p. 165, 1864.

[3] Mr. Carter (*loc. cit.*, p. 35) calls the Family "Teichonia" and "Teichonellidæ" indifferently. In order to render it uniform with the names Asconidæ, Syconidæ, and Leuconidæ, I propose to call it Teichonidæ.

Eilhardia, n. gen.

Teichonidæ of calyciform shape; that surface which carries pores supported by triradiate and minute acerate spicules, that which bears oscula supported by large acerate spicules.



I have now finished my account of the genera; their conjectural mutual phylogenetic affinities may be expressed graphically by the above diagram.

The first half of my task is therewith accomplished, and the best conclusion I can give to it will consist in signalising the merits of the investigator whose name has been

so frequently repeated in these pages. Of Prof. Hæckel's statements many have proved to be erroneous, but it must not be forgotten that it was his Monograph that called forth and facilitated later investigations, and if we are forced to agree to a certain extent with the judgment of M. Barrois upon the work just mentioned, that "l'imagination y a trop souvent pris la place de l'observation scientifique et froide," every one will also agree with the other judgment of the same naturalist, that with the appearance of Prof. Hæckel's Monograph "l'histoire des Éponges entra dans une phase nouvelle."[1]

I might now pass on to the description of the forms brought home by the Challenger Expedition. I prefer, however, at this point to summarise the few observations of histological interest which I was able to make during the examination of the Challenger material. I have already spoken of the interesting modifications which the pavement-cells undergo under certain circumstances. The flagellated cells are so sensitive to every kind of preservation that I can state nothing new about their properties.

There consequently remains only the mesoderm to be discussed. Besides its usual cellular elements, distinguished by Prof. Schulze[2] as amœboid and stellately ramified cells, which I was able to discern in all the Challenger Calcarea, in two cases (*Ute argentea* and *Leuconia multiformis*) I observed some very remarkable elements which seem to be intimately connected with the formation of the skeleton. Their form is shown on Pl. VI. fig. 3*c*. In comparison with the other elements of the mesoderm, these cells are pretty large, but flatly compressed, and forming with their protoplasm—perhaps under the influence of the preservation in alcohol—a kind of irregular network; all are provided with a comparatively large oval, or round nucleus. Such cells I found always in twos and threes upon spicules, upon large acerate spicules of *Ute argentea*, and large triradiate spicules of the parenchyma of *Leuconia multiformis*. It is known (Metschnikoff[3]) that calcareous spicules develop in the interior of the mesodermic cells. It may, however, happen—and this is very plausible—that in the cases where the spicula reach a considerable size, some other mesodermic cells are also concerned in their growth.

In addition to the spicules, there are in the sponge generative elements which in their turn are products of the mesoderm. Indubitable young ova—at least in large numbers—I have observed only in two cases: in *Leucetta vera* and in *Pericharax carteri*. In *Pericharax carteri* the ova were of the extraordinary size of 0·3 mm. in diameter, and seemed, like ova of *Spongilla* (Ganin[4]), to be surrounded by an endothelium. Larvæ I found in the following species:—*Sycon raphanus*, *Sycon arcticum*,

[1] Embryologie, &c., p. 8.
[2] *Zeitschr. f. wiss. Zool.*, Bd. xxv. Suppl. p. 253, 1875.
[3] *Ibid.*, Bd. xxxii. p. 370, 1879.
[4] Contributions, &c., p. 14.

Heteropegma nodus gordii, Leucilla uter, Leuconia typica. In all these cases the larvæ belonged to the type known under the name of Amphiblastula.

As far as the spermospores are concerned, I can only corroborate my former statements[1] as to their existence in the Calcarea, as well as in reference to the mode of their development. I have observed them in *Leucosolenia poterium* (?), in most of the Syconidæ, in *Leucilla uter, Leuconia multiformis, Leuconia typica, Leucetta hæckeliana, Eilhardia schulzei,* in *Sycon arcticum* and *Leucilla uter* together with Amphiblastulæ. In one specimen of *Leucosolenia poterium* (?) the spermospores were pretty numerous; but in almost all cases I found them outside the walls of the sponge, close to the flagellated cells. I was not able to account for this strange phenomenon, till Dr. Vosmaer kindly showed me this spring in Naples some sections with spermospores made from an Asconid exceedingly well preserved. As the observation belongs to Dr. Vosmaer and not to me I cannot here enter into particulars; I can only say that what I have seen in his preparations gives a very simple explanation of how Prof. Hæckel arrived at his statements[2] as to the endodermic origin of the spermospores. Be that as it may, their *mesodermic* origin is beyond all doubt, and, apart from the Syconidæ and Leuconidæ, I found in one case in the same *Leucosolenia poterium* (?) one spermospore lying quite obviously in the mesoderm. No mistake was possible, for it was found in a spot forming a common meeting-point of several branches of the colony, so that the mesoderm appeared in the section, not as usually happens in the Asconidæ as a, so to speak, mathematical line, but as a plane of comparatively broad surface. In this (Pl. III. fig. 1), as well as in other instances, a thin membrane around the spermospore was to be discerned very easily. In two cases this membrane had a slight thickening upon it as represented in the figure just alluded to, which I am inclined to regard as corresponding to the place of the nucleus of the covering cell. This supposition will appear to the reader very natural if he compare the picture just mentioned with the fig. 2*f*, Pl. VI. representing two spermospores of *Leucilla uter.* The few spermospores I was able to discover in *Leucetta hæckeliana* were found lying, not in the parenchyma, but in the cortex, not very far, however, from the zone of the flagellated chambers (Pl. VIII. fig. 2).

It is a very interesting fact that the mode of development of the spermospores, as I have described it in *Sycandra raphanus,* by no means seems to be confined to the Class Calcarea. I have also found the same in a horny sponge (an Aplysinid), and I shall return to the matter in my Report on the Challenger Keratose Sponges; and as in the form just mentioned the spermospores are also very small, there can—in view of F. E. Schulze's statements as to the spermatogenesis in *Aplysilla,*[3] *Spongelia,*[4] and

[1] *Sitzungsb. d. math.-naturw. Cl. d. k. Akad. d. Wiss. Wien,* Bd. lxxxvi. p. 277, 1882.

[2] Kalkschwämme, Bd. i. p. 150.

[3] *Zeitschr. f. wiss. Zool.,* vol. xxx. p. 412, 1878.

[4] *Ibid.,* vol. xxxii. p. 145, 1879.

Hircinia,[1]—be but one alternative possible: either the physiological explanation I have given[2] of the existence in the spermospores of a covering cell is really right, or, if the covering cell is of a more profound morphological signification, it ought to be present in the spermospores of all the Sponges. This last supposition is, of course, very plausible; I must add, however, that hitherto my search for this structure in *Aplysilla* and *Halisarca* has proved unsuccessful.

[1] *Ibid.*, vol. xxxiii. p. 28, 1880.

[2] *Loc. cit.*, p. 292.

II.—DESCRIPTION OF SPECIES.

Class CALCAREA, Bowerbank.

Porifera whose skeleton is composed of calcareous spicules.

Order HOMOCŒLA, Poléjaeff.

Calcarea without separate flagellated chambers, the whole of whose inner surface is covered with flagellated cells.

Family Asconidæ (Ascones), Hæckel.

Of the characters of the Order.

Leucosolenia, Bowerbank.

Of the characters of the Family.

Leucosolenia poterium (?) Hæckel, sp. (Pl. III. figs. 1, 2).

Ascetta primordialis, var. *poterium*, Hæckel, Kalkschwämme, Bd. ii. p. 16.
Clathrina poterium, Ridley, Proc. Zool. Soc. Lond., 1881, p. 133.

One of the four varieties established by Prof. Hæckel for his *Ascetta primordialis*, the variety *poterium* has recently been elevated by Mr. Ridley to the rank of an independent species. In this course Mr. Ridley was supported by the fact that the sponge, having been previously found only in Australia, was also dredged in the year 1878 in Tom Bay, south-west Chili, and proved, furthermore, to be constant in its main characters, notwithstanding the distance between these two localities. As properties distinguishing the

Note.—The technical terms:—gastric, subgastric, tubar, subdermal, and dermal, are used here with the meanings applied to them by Hæckel in his Kalkschwämme. All the measurements were made with instruments by R. Winkel, of Göttingen. The specimens were examined by means of sections stained with picro-carmine and mounted in Canada balsam. The indication of the colour refers to the specimens preserved in spirit.

form in question from *Ascetta primordialis*, H., Mr. Ridley states—1, that the minimum diameter of its largest spicule-rays exceeds 0·02 mm.; and 2, that it possesses a special dermal set of triradiate spicules, considerably larger than those subjacent to them.

Now I have numerous specimens from the Australian coast, all of which, presenting the auloplegma-form and being provided with pseudostomata, differ from *Clathrina poterium*, R., only in one important character, viz., the presence in the membrane of the pseudostome of sagittal, occasionally irregular triradiate, spicules, of the size of the smaller subdermal spicules, and just of the same form as the oscular triradiate spicules in my *Leuconia dura* (Pl. VII. fig. 7). If my supposition be true, and if such triradiates were wanting in the Australian specimens examined by Prof. Hæckel, and in the American ones described by Mr. Ridley—all these specimens having always presented the auloplegma-form—only for the reason that the delicate pseudostomial membrane was torn off in the dredging,—the species *Leucosolenia poterium* would receive still sharper determination, both by its constancy in form (auloplegma) and by the presence of peculiar triradiate spicules in the peristomial membrane. This latter character I consider to be particularly important, for the triradiate spicules in question I find in all the specimens I have of my conjectural *Leucosolenia poterium*, while with respect to the special dermal set of larger triradiate spicules, these specimens present a series of transition-forms, beginning with those whose outer spicules are almost of the same size as those of the interior of the colony, and ending with forms whose dermal triradiate spicules are, each ray, 0·3 mm. long, and 0·035 mm. in diameter; in all these cases the rays of the subdermal spicules, in accordance with Prof. Hæckel's statements, being 0·12 to 0·18 mm. long, and 0·006 to 0·01 thick. Some subdermal spicules show an incipient fourth ray.

I found in the specimens neither ova nor larvæ, and the spermospores, sparsely scattered here and there, were the only generative elements I observed in the examination (Pl. III. figs. 1 and 2).

Colour.—White and yellowish.

Habitat.—Station 163, April 4, 1874; lat., 36° 56′ S., long., 150° 30′ E.; off Two-fold Bay, Australia; depth, 120 fathoms,.

Leucosolenia lamarckii, Hæckel, sp.

Ascaltis lamarckii, Hæckel, Kalkschwämme, Bd. ii. p. 60.

The two specimens of this species were found attached side by side to an alga, both presenting the auloplegma-form, and each being provided with a pseudostome. The larger specimen has rounded angles, the smaller is an oval cylinder; the longitudinal axis of the larger attains a length of 9 mm., that of the smaller one does not exceed 5 mm. The measurements of the spicules agree with those of Hæckel for his *Ascaltis lamarckii*, var. *agassizii*; all the spicules, however—not only the larger triradiate—showing a

tendency towards sagittal differentiation, and the rays of the larger triradiate spicules being of still greater dimensions and rather stouter. They attain the length of 0·5 mm. with a diameter of 0·06 mm. I do not think that these differences would justify the establishment of a new variety.

Hitherto *Leucosolenia lamarckii* has been found only in the Atlantic; its distribution is now extended into the Pacific.

Colour.—White.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth 30 to 35 fathoms; rock.

Leucosolenia blanca, Miklucho-Maclay, sp. (Pl. I. fig. 2; Pl. III. fig. 3).

Guancha blanca, Miklucho-Maclay, Jenaische Zeitschr., Bd. iv. p. 220, 1868.
Ascetta blanca, Hæckel, Kalschwämme, Bd. ii. p. 38.

No auloplegma-forms of *Leucosolenia blanca* had previously been observed with well-developed peduncle. Miklucho-Maclay (*loc. cit.*, p. 223) states that the Sponge can occasionally sink down instead of growing upright, and extend upon the ground in the form of a bolster. Such bolster-like specimens are the only colonies presenting the auloplegma-form, but their peduncles become rudimentary. Now both the specimens of this species collected by the Challenger, although without any trace of the osculum, are provided with a peduncle one and a half times as long as the longitudinal axis of the colony itself. Taking into consideration that the specimens observed by Miklucho were found in shallow water, while those of the Challenger Expedition, on the contrary, were dredged up from the depth of 450 fathoms, and further, that while no colonial specimens of Miklucho-Maclay exceeded 3 to 4 mm. in length, and 1·5 to 2·5 mm. in diameter, the larger Challenger specimen is 25 mm. long, with a broadest diameter of 15 mm.; taking all this into consideration, I think it very probable that the typical *Leucosolenia blanca* belongs to the comparatively deep-water forms. If this could be proved, the possession of a solid peduncle might be used as a generic character, and a new genus, *Guancha*, established amongst the Asconidæ. This conjectural genus would consist of *Leucosolenia blanca*, presenting a transition form to the sessile Asconidæ, of the species described by Metschnikoff,[1] and characterised by the horn-shaped triradiate spicules in the peduncle, and of my *Leucosolenia challengeri*.

Future investigations will decide the question, and meanwhile I establish for my two specimens a third variety with the following diagnosis:—

Leucosolenia blanca, var. *bathybia* (Pl. I. fig. 2).—Basal ray of the triradiate spicules not more than 1·2 to 1·5 times as long as lateral rays.

[1] Spongiologische Studien, *Zeitschr. f. wiss. Zool.*, Bd. xxxii. p. 361, 1879.

As I remarked before, the peduncle is solid, the endodermic cavities of the adjacent tubes not extending deeper than its superior part. Its cellular elements consist of amœboid cells, distinguished by very large granules (Pl. III. fig. 3); there are also amongst them common amœboid cells, such, for instance, as F. E. Schulze [1] describes in *Sycandra raphanus*. The same elements are also to be found in the mesoderm of the tubes, but much more sparsely than in the peduncle. The outer epithelium of the tubes proved also to be coarse-grained; that of the peduncle could not be discerned. I regard these coarse-grained mesodermic cells as carrying nutritious elements, and explain their predominence in the peduncle by its solidity.

The larger Challenger specimen is represented in Pl. I. fig. 2.

To the habitat of *Leucosolenia blanca*, as given by Hæckel (*loc. cit.*, p. 39), must be added the Mediterranean Sea. The Sponge has been found in the Gulf of Naples (Vosmaer [2]), and there are also at the Institute in Graz some specimens from the Adriatic.

Colour.—Pale yellowish.

Habitat.—Station 75, July 2, 1873; lat. 38° 37′ N., long. 28° 30′ W.; off the Azores; depth, 450 fathoms; sand.

Leucosolenia challengeri, n. sp. (Pl. I. fig. 1; Pl. III. fig. 4).

This form can be distinguished from other species of *Ascetta*, in the sense of Hæckel, by the presence of a special set of triradiate spicules covering the outer surface of the colony, these spicules being all sagittal, while the triradiate spicules of the interior are all regular. The only specimen I find in the Challenger collection presents the soleniscus-form, the diameter of the tubes, *i.e.*, individuals of the colony, varying from 0·3 to 0·8 mm.; the pseudopores are still narrower, rarely exceeding 0·28 mm. in diameter; the oscula, sparsely scattered here and there, possess the same dimensions, or are rather larger. The whole forms an irregularly oval body 30 mm. long and 20 mm. broad in its thickest part, presenting a compact web of minute tubes and terminating in a short (2 mm.) peduncle. This latter is solid, at least in its interior part, and so far as the state of preservation permits one to judge, contains cellular elements like those in the peduncle of *Leucosolenia blanca*.

Skeleton.—Two forms of spicules are to be distinguished,—regular and sagittal triradiate.

The regular spicules are very like those of *Leucosolenia coriacea*, John., var. *multicavata*, H. (Kalkschwämme, Bd. ii. p. 25); their rays (0·18 mm. long) are slender (16 to 20 times

[1] Ueb. d. Bau. u. Entw. v. Sycandra raphanus, *Zeitschr. f. wiss., Zool.*, Bd. xxv., Suppl. p. 253, 1875.

[2] Voorloopig berigt omtrent h. onderzoek aan de Nederl. werktafel in h. Zool. St. te Napels, Haag, 1881, p. 5.

as long as thick), cylindrical, with rounded ends; the basal ray is sometimes rather longer than the lateral; some of them show an incipient fourth apical ray.

The sagittal triradiate spicules are on an average of the same size as the regular; their rays, compared with those of the latter, are more conical, although there is no want of intermediate stages. They are inconstant in their outlines. With some of them the irregularity consists only in their not being flat, the point of meeting of the rays not lying in the same plane as their ends, the basal ray being in this case either of the length of the lateral rays or rather longer; but such a form is comparatively rare. The greater part also show variation in their angles, the angle formed by the basal and each of the lateral rays varying from 120° to 92°; the length of the basal ray is in this case variable (0·12 to 0·25 mm.); it is either straight or undulating, the lateral rays being horn-shaped, and curved more or less one towards the other.

There exists also on the outer surface of the colony another constituent part of the dermal set, namely, large regular triradiate spicules, each ray attaining a length of 0·8 mm., and a diameter of 0·06 mm.; but these spicules are so extremely rare, that they are of no consequence for systematic purposes.

Colour.—Yellowish.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; Cape York, Australia; depth, 8 fathoms; coral sand.

Order HETEROCŒLA, Poléjaeff.

Calcarea with separate flagellated chambers lined with flagellated cells, the remaining parts of the inner surface being covered with pavement-epithelium.

Family Syconidæ (Sycones), Hæckel.

Heterocœla whose large cylindrical flagellated chambers (*tubi radiales*, auctorum), show a radial disposition with respect to the central cavity, communicating with it directly without the mediation of any exhalent canals.

Sycon, Risso.

Syconidæ with articulated tubar skeleton, with radial tubes either quite free or, if grown together, united in such a manner that the individuality of every tube may be easily discerned, owing to the absence of any independent cortex.

Sycon raphanus, O. Schmidt.

Sycon raphanus, O. Schmidt, Spong. d. adriatisch. Meeres, Bd. i. p. 14, 1862.
Sycandra raphanus, Hæckel, Kalkschwämme, Bd. ii. p. 312.

There are amongst the Challenger Syconidæ two specimens which I determine as *Sycon raphanus*, var. *tergestinum*, H., their skeleton presenting no difference from that of the variety just named, and the chief specific character of *Sycon raphanus*, *i.e.*, the slenderness of the subgastric triradiate spicules in comparison with other spicules of the skeleton, being expressed very clearly. Most of these slender spicules are clearly triradiate, some of them are provided with a short apical ray, rarely exceeding 0·05 mm. in length. This is, however, no special character of the Challenger specimens; I have also observed it in those from the Adriatic, and think it to be common to the whole species. Both the specimens proved to be full of Amphiblastulæ.

Colour.—Pale yellowish.

Habitat.—Station 135, October 16, 1873. Island of Tristan da Cunha. Depth, 60 to 90 fathoms; rock, shells. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Sycon arcticum, Hæckel, sp. (Pl. III. fig. 5).

Sycandra arctica, Hæckel, Kalkschwämme, Bd. ii. p. 353.

Sycon arcticum can be easily distinguished from all other species of the genus by the equal size of its tubar, gastric, and subgastric spicules, by their slenderness, and by the circumstance that most of the tubar spicules are not triradiate but quadriradiate, with a more or less developed apical ray.

There is also, according to Hæckel, another more important distinction, viz., the absence of the intercanals; but we have already seen that this is erroneous. The intercanals are in *Sycon arcticum*, as in every *Sycon*, in their usual places, and their course is represented on Pl. III. fig. 5. Both the Challenger specimens of the species, one from the Philippine Islands, the other from the Bermuda Islands, must be determined as var. *maximum*, H. I did not find any generative elements in the former; but, on the contrary, the specimen from the Bermuda Islands proved to be full of larvæ (Amphiblastulæ) and spermospores.

Sycon arcticum has hitherto been considered to be an exclusively arctic sponge; its distribution must now be extended southwards, but it is to be noticed that while its arctic forms belong to the largest of the Syconidæ, their body reaching 50 mm. in length

(Hæckel), neither of the Challenger specimens exceeds 18 mm., including the collar fringed by fine linear acerate spicules 4 mm. in length.

Colour.—White and yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms; mud. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Sycon arboreum, Hæckel, sp. (Pl. I. fig. 4).

Sycandra arborea, Hæckel, Kalkschwämme, Bd. ii. p. 331.

There are four specimens of this Sponge in the Challenger collection, each presenting a colony of 9 to 13 individuals (Pl. I. fig. 4). The measurements of the spicules agree with those of Hæckel, the only differences being the length of the apical ray of the gastric quadriradiate spicules, which, usually exceeding the extreme length of 0·08 mm. given by Hæckel, not seldom reaches 0·25 mm., and the length of the acerate spicules of the collar, which are never longer than 1 mm., and often still shorter (0·5 to 1 mm.). The specimens were not particularly well preserved, but nevertheless, strange to say, the epithelium of the outer surface could be discerned more perfectly than I had ever seen it before, even by the aid of the osmic acid and gold methods. Accordingly, the course of the intercanals could be studied very easily, and I must state that the intercanals and the radial tubes of *Sycon arboreum*, as well as those of *Sycon elegans*, *Sycon raphanus*, *Sycon quadrangulatum*, &c., are by no means regular enough to admit of their geometric outlines being utilised for systematic purposes (Hæckel[1]), much less for the subdivision of the genus into sub-genera. Moreover, such a subdivision is unnecessary, for all the species of *Sycon* hitherto described can be very easily distinguished one from another by means of other characters.

The Challenger specimens of *Sycon arboreum*, like those examined by Hæckel, are all from the southern or eastern coast of Australia.

Colour.—Dirty yellowish.

Habitat.—Station 162, April 2, 1874; off East Moncœur Island, Bass Strait, Australia; depth, 38 to 40 fathoms; sand.

Grantia, Fleming.

Syconidæ with articulated tubar skeleton, with radial tubes which have lost every trace of individuality, owing to the existence of a thin, yet quite independent, cortex, its skeleton consisting principally of triradiate spicules.

[1] Kalkschwämme, Bd. ii. p. 290.

Grantia tuberosa, n. sp. (Pl. I. fig. 6; Pl. III. figs. 6–13).

This Sponge differs from all other species of the genus by its large acerate spicules, which sometimes stand perpendicularly to the surface of the Sponge, but usually turn down into the parenchyma, not only piercing it in an oblique direction, but also—and this is very often the case—lying parallel to the outer surface, and thus either perpendicularly to the longitudinal axis of the Sponge, or parallel to it, or forming with it a more or less acute angle. This is a very interesting fact, for it indicates how a cortex of acerate spicules longitudinally disposed,—the chief character of the genus *Ute*—might have taken origin.

The species is represented in the Challenger collection by a complete specimen and some fragments. The first is of tubular form with extended base, 15 mm. long and 6 mm. broad in the middle; the thickness of the walls reaches 1 mm., the diameter of the osculum 2·25 mm. On one side of the outer surface are to be seen two nodular prominences, perpendicular to the longitudinal axis of the Sponge—probably incompletely developed gemmæ. Such a transverse gemmation has been also observed in *Amphoriscus stauridia* (Hæckel[1]). The outer surface is smooth, the inner surface slightly roughened by the apical rays of the gastric quadriradiate spicules. The radial tubes are irregular in their outlines, and show a tendency to ramify; the tubar pores are in this species larger and more numerous than I have ever seen them; the disposition of the tubar spicules is not so regular as is usually the case in the tubes with articulated skeleton.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate or quadriradiate, of tubar triradiate, of large acerate, of minute cortical acerate, and of cortical sagittal and irregular triradiate spicules.

Gastric quadriradiate spicules.—All the rays of the same diameter (0·012 mm.), tapering from the base to sharp points; basal ray straight, often rather shorter than lateral rays, these latter being on an average 0·3 mm. long; lateral rays smooth, either straight or slightly curved, forming with basal ray an angle of about 115°; apical ray curved, rarely longer than 0·08 mm.

Subgastric triradiate spicules.—All the rays of the same diameter (0·02 mm.); basal ray straight, tapering from the base to a sharp point, reaching 0·38 mm. in length, forming with each of the lateral rays an angle of about 110°; lateral rays sharp-pointed, curved, often undulating, either lying in the same plane with basal ray or forming with one another an angle varying from 180° to 165°. Many of the subgastric triradiate spicules are provided with embryonal fourth rays, occasionally reaching 0·04 mm. in length, but half as thick as the other rays.

Tubar triradiate spicules.—All the rays sharp-pointed, of the same diameter (0·02 mm.), lying in the same plane; basal ray straight, its length varying from 0·12 to 0·28 mm.; lateral rays curved outwards, often undulating, 0·25 mm. long, each forming with basal ray an angle varying from 112° to 130°.

[1] Kalkschwämme, Bd. ii. p. 246.

Large acerate spicules.—Either straight or slightly curved, spindle-shaped, tapering from the middle to a sharp point at either end, reaching 1·2 mm. in length and 0·065 mm. in diameter.

Minute acerate spicules.—Of the same form as the large acerate spicules, on an average 0·05 mm. long and 0·0025 mm. thick; scattered without any order in heaps, or isolated amongst the cortical triradiate spicules.

Sagittal triradiate spicules of the cortex.—Lateral rays smooth, sharp-pointed, either straight or slightly curved, either inwards or outwards, forming with the basal ray an angle varying from 90° to 100°; 0·1 to 0·3 mm. long, the proportion between the length and the thickness varying from 20 : 1 to 35 : 1; basal ray straight, tapering from the base to a sharp point, three to five times as short and usually twice as thin as the lateral rays.

Irregular triradiate spicules of the cortex.—All the rays approximately of the same size, reaching 0·07 mm. in length, 0·003 mm. in diameter. Too rare to be of any systematic importance.

Colour.—White.

Habitat.—Off St. Vincent, Cape de Verde Islands; July, 1873.

Ute, O. Schmidt.

Syconidæ, the skeleton of whose strongly developed cortex consists principally of large acerate spicules lying in several layers parallel to the outer surface of the Sponge.

Ute argentea, n. sp. (Pl. I. fig. 3; Pl. IV. fig. 3; Pl. V. fig. 1*a*–1*p*).

There is in the Challenger collection only one specimen of this species; it presents an elongated tube, 40 mm. long, with a diameter of 3 mm., becoming rather narrower at either end. The thickness of the walls does not exceed 0·5 mm., that of the cortex reaches 0·25 mm.; the outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The specimen is bare-mouthed, and like the second species of the genus, *Ute glabra*, distinguished by the silvery lustre of its outer surface. The radial tubes are of cylindrical form; their course, as well as that of the intercanals, can be seen on Pl. IV. fig. 3. The tubar skeleton is non-articulated, and this is the chief character differentiating *Ute argentea* from *Ute glabra*.

Skeleton.—The skeleton of *Ute argentea* is so very complicated, that I prefer to describe it in separate divisions as follows :—

Skeleton of the gastric surface.—This consists of an outer layer of quadriradiate, of an inner layer of quadriradiate or triradiate, and of minute acerate spicules, scattered amongst those just mentioned without any regular order.

Outer quadriradiate spicules.—Basal and lateral rays straight, sharply or rather bluntly pointed, all of the same diameter (0·01 mm.), and usually of the same length (0·25 mm. on an average); basal ray forming with each of lateral rays an angle of 115°; apical ray

curved, tapering from the base to a sharp point, reaching 0·15 mm. in length with a diameter of 0·01 (Pl. V. fig. 1*d*).

Inner quadriradiate spicules.—Basal ray straight, tapering from base to sharp point, usually rather thinner than lateral rays, forming with each of them an angle of about 100°, length inconstant, varying from 0·18 mm. to 0·5 mm.; lateral rays curved inwards, tapering from the base to sharp points, reaching 0·3 mm. in length, 0·0125 mm. in diameter; most of them are truly quadriradiate, their apical ray being occasionally longer (0·2 mm.) than that of the outer quadriradiate spicules; its length is, however, variable, and there are amongst the inner quadriradiate spicules others with a merely embryonal apical ray, and even quite deprived of it (Pl. V. figs. 1*e*, 1*f*).

Minute acerate spicules.—Straight or slightly curved, spindle-shaped, tapering from the centre to a sharp point at either extremity, usually 0·1 mm. long, 0·002 mm. in diameter.

Skeleton of the radial tubes.—The tubar skeleton consists of subgastric triradiate spicules, reaching with their centrifugally directed basal ray the zone of the cortical acerate spicules, of tubar acerate spicules lying parallel to the basal ray just mentioned, and of tubar quadriradiate spicules scattered here and there at the bottom of the radial tubes.

Subgastric triradiate spicules.—All rays of the same thickness (0·013 mm.); basal ray straight, tapering from the base to a sharp point, its average length 0·3 mm.; lateral rays slightly curved inwards, forming with basal ray an angle varying from 100° to 110°, rarely exceeding 0·15 mm. in length (Pl. V. fig. 1 *a*).

Tubar quadriradiate spicules.—All rays in different planes, lateral rays forming one curve, basal and apical rays another; basal ray bluntly pointed, cylindrical, 0·0025 mm. thick, rarely longer than 0·003 mm.; lateral rays straight or slightly curved, tapering from the base to sharp points, each forming with basal ray an angle of about 110°, reaching 0·05 mm. in length, with a diameter of 0·002; apical ray slightly curved, sharp-pointed, of the same diameter as lateral rays, but usually three times shorter (Pl. V. fig. 1 *g*).

Tubar acerate spicules.—Straight or slightly curved, tapering from the centre to sharp points, rarely longer than 0·3 mm., with a diameter of 0·005.

Skeleton of the cortex.—The skeleton of the cortex consists of large spindle-shaped acerate, of minute acerate, and of sagittal triradiate spicules, with the basal ray directed towards the closed end of the Sponge.

Large acerate spicules straight or slightly curved, tapering from the centre to a sharp point at either end; length varying from 1 to 3 mm., diameter from 0·05 to 0·12 mm.

Minute acerate spicules.—Like those of the gastric surface spindle-shaped, straight, or slightly curved, tapering from the centre to the sharp points; rarely exceeding 0·15 mm. in length, and 0·0028 mm. in diameter.

Sagittal triradiate spicules.—Basal ray smooth, either of cylindrical form or tapering from the base to a sharp point, reaching 0·75 mm. in length, with a diameter of 0·005; lateral rays sharp-pointed, forming with basal ray an angle of 112°, either straight or more

frequently slightly curved, usually inwards, twice as thick as basal ray; length inconstant, varying from 0·025 mm. to 0·12 mm.

Colour.—White.

Habitat.—Station 163, April 4, 1874 ; lat. 36° 56′ S., long. 150° 30′ E. ; depth, 120 fathoms ; off Twofold Bay, Australia.

Heteropegma, n. gen.

Syconidæ with articulated tubar skeleton, the supporting skeleton of whose strongly developed cortex consists of triradiate and quadriradiate spicules, quite different in size from those of the parenchyma.

Heteropegma nodus gordii, n. sp. (Pl. I. fig. 7 ; Pl. IV. figs. 1*a*–1*d*).

This species, represented in the Challenger collection by two specimens, forms colonies of a rather Asconoid appearance. The tubes, sometimes standing vertically, sometimes lying horizontally, ramify and interlace, thus constituting a kind of knot in which neither beginning nor end can be discerned. The individuality of the tubes is expressed only by oscula, these latter being naked. In one specimen, from Australia, the oscula are numerous, while, if present at all, they seem to be much more scanty in the other, from Bermudas. It must be said, however, that this latter specimen was quite crushed and crumpled.

The size of the oscula is inconstant, varying from 0·25 to 1 mm. in diameter. Both the surfaces are rough. The average thickness of the walls is 1 mm., the diameter of the inner cavity 1 mm. in the Australian specimen, 2 mm. in that from Bermudas. The radial tubes are of irregular outline, and show a great tendency to ramify (Pl. IV. fig. 1*a*).

The specimen from Bermudas proved to be sterile ; but in the radial tubes of that from Australia I found some Amphiblastulæ.

Skeleton.—The skeleton consists of minute tubar and gastric quadriradiate, of much larger triradiate and quadriradiate cortical, and of triradiate oscular, spicules.

Skeleton of the parenchyma.—The typical modifications of the tubar and gastric quadriradiates are represented on Pl. IV. fig. 1*a* ; there are also amongst them triradiate spicules of the same outlines and size, but they are not numerous. The tubar quadriradiate spicules are regular, their rays either tapering from the base to a sharp point, or of cylindrical form with truncated ends ; in both cases the proportion between the length and the thickness of the rays at their base remaining the same (30 : 1), their length being 0·06 mm., their diameter 0·002 mm. These regular spicules of the radial tubes are connected by all possible intermediate stages with sagittal and irregular quadriradiate spicules supporting

the inner surface. Constant as to the thickness of their rays, only near the osculum exceeding 0·002 mm., the gastric quadriradiate spicules vary extremely with regard to the comparative length of the rays, as well as with regard to their form and their angles. The apical rays, which, in the tubar quadriradiates do not exceed the length of the facial rays, and are often still shorter, grow much longer in the gastric quadriradiate spicules, and near the oscular part of the tube attain 0·18 mm. in length, 0·005 mm. in diameter, the corresponding facial rays rarely exceeding the length of 0·06 mm., the lateral rays remaining of the same diameter (0·005 mm.), the basal ray growing rather thinner.

Skeleton of the cortex.—The triradiate and quadriradiate spicules of the cortex are regular, their rays sharp-pointed, more or less stout, the proportion between their length and thickness varying from 6 : 1 to 12 : 1. With respect to their dimensions, the quadriradiate are connected with the triradiate spicules by intermediate stages; the length of the rays of the quadriradiate reaching 1 mm., that of the rays of the triradiate not exceeding 0·6 mm. These spicules lie apart from the centripetally directed apical ray of the quadriradiate spicules, parallel to the outer surface, but the direction of their basal rays is variable.

Skeleton of the osculum.—The skeleton of the border of the oscular circle consists exclusively of rectangular sagittal triradiate spicules, marked out by their horn-shaped lateral rays, lying parallel to the line of the border. Their size is extremely inconstant, the length of the rays varying from 0·05 to 0·25 mm., and the proportion between the length and the thickness from 10 : 1 to 20 : 1 The comparative length of the basal ray is also variable; in most cases, however, this ray is shorter and rather thinner than the lateral.

Colour.—Yellowish-grey.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; Cape York, Australia; depth, 8 fathoms; coral sand.

Amphoriscus, Hæckel.

Syconidæ with non-articulated tubar skeleton, the supporting spicules of whose comparatively thin cortex are either triradiate or quadriradiate, or both triradiate and quadriradiate together.

Amphoriscus poculum, n. sp. (Pl. IV. fig. 4; Pl. V. figs. 2*a*–2*f*).

The single specimen representing this species in the Challenger collection is of tubular elongated form, 36 mm. long. 4 mm. broad in its middle and superior part; towards the closed end the tube becomes rather narrower. The individual is bare-mouthed; the outer and inner surfaces are slightly roughened by the cortical and gastric triradiate spicules respectively; the average thickness of the walls does not exceed 0·6 mm.

From the species showing the closest relation to it, *Amphoriscus poculum* can be distinguished by the following characters:—from *Amphoriscus stauridia* (*Sycetta stauridia*, H., Kalkschwämme, Bd. ii. p. 245), by the presence of acerate spicules; by the sagittal dermal and gastric triradiate spicules, the corresponding ones in *Amphoriscus stauridia* being regular; by the irregular subdermal triradiate spicules, which are sagittal in *Amphoriscus stauridia*. From *Amphoriscus sycilloides* (*Sycortis sycilloides*, Schuffner[1]) it is distinguished by the presence of acerate spicules in the body of the Sponge itself, which occur in *Amphoriscus sycilloides* only in the peristome; by the sagittal subgastric triradiate spicules, these being irregular in *Amphoriscus sycilloides;* and by the form of the dermal and gastric triradiate spicules.

Skeleton.—The skeleton consists of gastric triradiate, of subgastric triradiate, of subdermal triradiate, of dermal triradiate and of acerate spicules.

Gastric triradiate spicules.—Sagittal; all rays in the same plane, and of the same diameter (0·015 mm.); basal ray straight, tapering from the base to a sharp point, length inconstant, usually one and a half times as long as lateral rays, often much shorter; lateral rays curved outwards, cylindrical, either sharply or rather bluntly pointed, each forming with basal ray an angle of about 110°, 0·25 mm. long on the average.

Subgastric triradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm.); basal ray straight, tapering from the base to a sharp point, usual length 0·38 to 0·45 mm; lateral rays sharp-pointed, curved, often angularly bent in their middle or basal part, rarely exceeding 0·275 mm. in length, forming with each other an angle varying from 170° to 140°, and with the basal ray an angle varying from 100° to 120°.

Subdermal triradiate spicules.—Irregular; all rays usually of the same thickness (0·015 mm.), but of different lengths, lying in the same plane; basal ray straight, tapering from the base to a sharp point, rarely exceeding 0·1 mm. in length, occasionally rather thinner than lateral rays, forming with each of these latter an angle of about 120°; lateral rays curved forwards, sharp-pointed, of different lengths, the longer, directed centripetally, reaching 0·35 mm., often, however, considerably shorter, scarcely longer than the shorter lateral ray, the length of which varies from 0·12 to 0·15 mm. The reasons which led me to regard the centripetally directed ray as one of the laterals are expounded in the morphological part of this memoir (p. 18).

Dermal triradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm.), usually sharp-pointed; basal ray straight, length inconstant, not exceeding 0·425 mm.; lateral rays curved, each forming with basal ray an angle of about 120°; average length, 0·25 mm.

Acerate spicules.—Usually spindle-shaped, often lanceolate, sharp-pointed; the lanceolate straight, the spindle-shaped either straight or slightly curved; attaining a length of 1 mm., and a diameter of 0·05 mm.; a few much shorter and stouter, the proportion between the length and the thickness being 6 : 1. Sparsely scattered in the parenchyma, their free

[1] *Jenaische Zeitschr.*, Bd. xi. p. 420, 1877.

ends projecting from the outer surface being usually broken off; piercing the wall perpendicularly to the longitudinal axis of the Sponge.

Colour.—Pale-yellowish.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Amphoriscus elongatus, n. sp. (Pl. IV. fig. 5; Pl. V. figs. 4*a*–4*e*).

This species is represented in the Challenger collection by one specimen in the form of an elongated tube, 50 mm. long., 3·5 mm. broad, growing rather narrower towards the lower end; near its free end the Sponge divides into two tubes, standing close together, and each terminating with a naked osculum. The outer surface is roughened by the cortical spicules, the inner surface is similarly roughened by the apical rays of the gastric quadriradiate spicules. The thickness of the walls does not exceed 0·6 mm. By its subdermal quadriradiate spicules the species can be distinguished from *Amphoriscus glacialis* (*Sycaltis glacialis*, H.), the corresponding spicules in the form just named being triradiate; the subgastric triradiate spicules differentiate this form from *Amphoriscus oviparus*, *urna*, *chrysalis*, &c., the corresponding spicules being represented in these latter species by quadriradiate ones.

The important anatomical peculiarity of *Amphoriscus elongatus*, namely, the tendency of the radial tubes to meet in threes, in fours, or in larger numbers around the same shallow invagination of the gastric cavity, is represented on Pl. IV. fig. 5.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of subdermal quadriradiate, of dermal triradiate, and of minute dermal acerate spicules, sparsely scattered in the cortex perpendicularly to the outer surface of the Sponge.

Gastric quadriradiate spicules.—All rays of the same diameter (0·016–0·02 mm.), either sharply or bluntly pointed; basal ray straight, reaching 0·45 mm. in length, forming with each lateral ray an angle varying from 115° to 122°; lateral rays either straight or slightly curved inwards, usual length 0·25 mm.; apical ray stout, curved, its length not exceeding 0·18 mm.

Subgastric triradiate spicules.—Sagittal; rays of the same dimensions and showing the same variations with regard to their angles as those of the corresponding spicules in *Amphoriscus poculum*, the sole distinction concerning the form of the lateral rays, these latter being not angularly curved but undulating. In accordance with the strong development of the subdermal quadriradiate spicules, the subgastric ones are not numerous, and show a tendency to grow smaller and thinner.

Subdermal quadriradiate spicules.—Sagittal; all rays sharp-pointed, usually of the same dimensions, their average length being 0·6 mm. and diameter 0·07 mm.; basal ray—occasionally rather shorter than lateral rays—straight; lateral rays slightly curved inwards, each forming with basal ray an angle of about 118°; apical ray straight, either of the length of facial rays or rather longer.

Dermal triradiate spicules.—Basal ray straight, tapering from base to sharp point, with a diameter of 0·015 mm.; length inconstant, not exceeding 0·45 mm.; lateral rays straight, cylindrical, rarely longer than 0·25 mm., one and a half times as thick as basal ray, each forming with this latter an angle of about 115°.

Dermal acerate spicules.—Slender, spindle-like, attaining a length of 0·1 mm. and a diameter of 0·0025 mm.

Colour.—Pale yellowish.

Habitat.—Station 145, December 27, 1873; lat. 46° 40′ S., long. 37° 50′ E.; off Prince Edward Islands; depth, 310 and 150 fathoms.

Amphoriscus flamma, n. sp. (Pl. I. fig. 5; Pl. V. figs. 3*a*–3*g*).

The species is represented in the collection by a colony of twenty tubular individuals, almost all of which are turned towards the same side, the whole producing the effect of the many tongued flame of a wood fire blown by the wind from the vertical direction. Each individual is provided with an osculum fringed by fine linear acerate spicules. The outer surface of the tubes is bristly, the inner surface is roughened by the apical rays of the gastric quadriradiate spicules. The diameter of the tubes is in different individuals of different sizes, varying from 3 to 7 mm. The average thickness of the walls is 1 mm. The form to which *Amphoriscus flamma* shows the closest relation is *Amphoriscus poculum*, but the presence of quadriradiate, the number of acerate, and the larger size of the subgastric and subdermal triradiate spicules necessitate the establishment of a new species.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of subdermal triradiate, of dermal triradiate, and of stout acerate spicules, piercing centripetally the wall of the Sponge, and projecting from the outer, often also from the inner, surface, as well as of fine acerate spicules of the osculum.

Gastric quadriradiate spicules.—Basal ray straight, either sharply or bluntly pointed, 0·15 to 0·25 mm. long, forming with each of the lateral rays an angle of about 125°; lateral rays curved outwards, of cylindrical form, length varying from 0·3 to 0·45 mm.; apical ray curved, 0·15 mm. long or less, usually sharply, not seldom bluntly pointed, like the lateral rays 0·01–0·0125 mm. thick, the basal ray being either of the diameter of the other rays or rather thicker.

Subdermal triradiate spicules.—Of the same form as the corresponding spicules in *Amphoriscus poculum*, but of different dimensions; all rays of the same diameter (0·03 mm.); average length:—basal ray 0·28 mm., shorter lateral ray 0·38 mm., longer lateral ray 0·5 mm.

Subgastric triradiate spicules.—Just of the same form as the subgastric triradiate spicules in *Amphoriscus elongatus*, but of larger size; basal ray reaching 0·7 mm., lateral rays 0·36 mm. in length, and 0·045 mm. in diameter. Some are provided with a rudimentary fourth ray.

Dermal triradiate spicules.—Sagittal; all rays of the same diameter, the proportion between the length and the thickness varying from 10 : 1 to 18 : 1; lateral rays curved forwards, reaching 0·5 mm. in length, each forming with basal ray an angle of about 120°; basal ray straight, its length not exceeding that of lateral rays, usually still shorter.

Stout acerate spicules.—Either spindle-shaped or of irregular form (Pl. V. fig. 3*e*); straight or slightly curved, some reaching over 2 mm. in length, with a diameter of 0·1 mm., most not exceeding 1 mm. in length and 0·06 mm. in diameter.

Fine acerate spicules of the peristome.—2 mm. and above in length and 0·0025 mm. in diameter, occasionally still thinner, sharp-pointed at both ends, the free end being, however, broken off in most cases.

Colour.—White.

Habitat.—Bahia; shallow water.

Anamixilla, n. gen.

Syconidæ without any special tubar skeleton, the supporting spicules of the parenchyma disposed in it like those in the Leuconidæ; in most cases, however, more or less parallel to the outer surface.[1]

Anamixilla torresi, n. sp. (Pl. IV. figs. 2*a*–2*c*).

The single specimen of *Anamixilla torresi* of the Challenger collection presents a colony of tubular individuals of similar aspect to *Amphoriscus flamma;* some individuals are bare-mouthed, some mouthless. The thickness of different individuals varies from 1 to 9 mm.; the width of the walls is more constant, reaching 1 mm. on the average. The inner surface is slightly roughened by the apical rays of the gastric quadriradiate, the outer surface in a still higher degree roughened by the cortical triradiate spicules.

Skeleton.—The skeleton consists of gastric quadriradiate, of gastric triradiate, of subgastric triradiate, of parenchymal triradiate, and of dermal triradiate spicules.

Gastric quadriradiate spicules.—All rays of the same diameter (0·02 mm.); basal ray straight, either sharply or bluntly pointed, of conical form, length varying from 0·16 to 0·4 mm., occasionally rather thicker than lateral rays, forming with each of these an angle of about 115°; lateral rays curved outwards, often slightly undulating, tapering from the base to a sharp point, usual length 0·35 to 0·4 mm.; apical ray curved, sharply pointed, its length not exceeding 0·06 mm.

Gastric triradiate spicules.—Rays smooth, tapering from the base to sharp points, reaching 0·4 mm. in length, with a diameter of 0·015 mm.; basal ray straight, lateral rays slightly

[1] With the exception of the subgastric triradiate spicules, disposed like those in the genus *Amphoriscus*, if these be not an exclusive attribute of the only species of the genus hitherto known, *Anamixilla torresi*.

curved inwards, each forming with basal ray an angle of about 110°; some of them are provided with embryonic apical rays, reaching occasionally 0·2 to 0·3 mm. in length.

Subgastric triradiate spicules.—Sagittal; lateral rays either lying in the same plane or forming with one another an angle varying from 180° to 140°; all rays of the same diameter, varying from 0·02 to 0·05 mm.; basal ray straight, tapering from the base to a sharp point, reaching 0·8 mm. in length; lateral rays curved, often undulating, usually half as long as basal ray, often of the same length, occasionally even longer, not exceeding, however, 0·8 mm.

Triradiate spicules of the parenchyma.—Either quite regular, or showing a slight tendency to sagittal differentiation; rays sharply pointed, maximum size about 1 mm., diameter varying from 0·1 to 0·125 mm.

Dermal triradiate spicules.—Regular, more slender than the triradiate ones just described; rays either tapering from the base to sharp points or of cylindrical form; average size of the rays 0·3 mm. in length by 0·02 mm. in diameter.

Colour.—Pale yellowish.

Habitat.—Torres Strait, Australia, September 7, 1874; depth, 3 to 11 fathoms.

Family Leuconidæ (Leucones) Hæckel.

Heterocœla, whose usually round flagellated chambers communicate with the central cavity not immediately but by means of its more or less deep lateral invaginations (exhalent canals), the corresponding opening of the flagellated chambers being of less diameter than that of the subjacent exhalent canals; with quite irregular disposition of the spicules in the parenchyma.

Leucilla, Hæckel (sensu mutato).

Leuconidæ with flagellated chambers of an elongated, cylindrical form, recalling that of the radial tubes of the Syconidæ, with the skeleton of the parenchyma bearing traces of a certain regularity in the arrangement of its constituent parts, owing to the disposition of the subgastric and subdermal spicules directly opposite to each other.

Leucilla connexiva, n. sp. (Pl. VI. figs. 1*a*–1*e*).

I can give but little information with regard to the external shape of this species. There is not in the Challenger collection one complete specimen of this interesting form, but only some fragments which have fortunately proved quite fit for anatomical examination. Both the surfaces are rather rough; the thickness of the walls is about 0·8 mm.; the disposition of the openings of the exhalent canals is far from being so

regular as that of the gastric openings of the radial tubes. The internal structure can be seen on Pl. VI. fig. 1*a*, but it must be noticed that, occasionally, the exhalent canals, like those in *Leucilla uter*, n. sp., give origin to secondary lateral invaginations.

Skeleton.—The skeleton consists of gastric triradiate, of subgastric triradiate, of triradiate spicules of the parenchyma, of subdermal and dermal triradiate spicules.

Gastric triradiate spicules.—All rays more or less cylindrical; basal ray straight, thinner than lateral rays, average size 0·325 by 0·015 mm.; lateral rays either straight or slightly curved outwards, each forming with basal ray an angle of about 110°; size 0·2 to 0·325 by 0·02 mm.

Subgastric triradiate spicules.—Sagittal; all rays of the same diameter of 0·028 mm.; basal ray straight, tapering from the base to a sharp point, reaching 0·55 mm. in length, forming with each of the lateral rays an angle varying from 110° to 120°; lateral rays sharp-pointed, slightly undulating, rarely longer than 0·3 mm., forming with each other an angle varying from 170° to 145°.

Triradiate spicules of the parenchyma.—All rays of the same diameter, not exceeding 0·045 mm., usually sharp-pointed; basal ray straight, forming with each of the lateral rays an angle varying from 115° to 120°, length inconstant, not exceeding 0·4 mm.; lateral rays either straight or slightly curved, often undulating, attaining a length of 0·5 mm., forming with one another an angle varying from 180° to 150°; not numerous, more or less imitating in their disposition the subgastric triradiate spicules.

Subdermal triradiate spicules.—In general of the same form as the corresponding spicules in *Amphoriscus poculum* and *Amphoriscus elongatus*. All rays of the same diameter (0·02–0·025 mm.), sharp-pointed; basal ray straight, rarely longer than 0·18 mm., forming with the longer lateral ray an angle of about 110°, with the shorter of about 118°; lateral rays curved outwards, the shorter often undulating, its length not exceeding 0·2 mm., the longer curved only at its base, almost straight further on, attaining a length of 0·4 mm. These spicules are disposed in such a manner that the angle formed by the basal ray and the shorter of the lateral rays is turned to the outer surface, the longer lateral ray being directed centripetally.

Dermal triradiate spicules.—More or less stout, the proportion between the length and the thickness of the rays varying from 7 : 1 to 12 : 1, some almost regular, all rays being of the same length, not exceeding 0·8 mm., and their angles of 120°; most either sagittal or irregular, the deviations consisting either in the differentiation of the plane of the ends of the rays and that of their crossing, or in the unequal length of the rays, or in the sagittal differentiation of the angles formed by basal and lateral rays, these angles varying from 120° to 125°, and the corresponding lateral rays growing rather curved outwards.

Colour.—Dirty yellowish.

Habitat.—Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Leucilla uter, n. sp. (Pl. VI. figs. 2*a*–2*f*).

From *Leucilla connexiva*, the form I am about to describe can be distinguished by its subdermal quadriradiate spicules, and by the absence of special cortical spicules, the function of these latter being performed by the facial rays of the quadriradiate spicules just mentioned. The main character differentiating *Leucilla uter* from *Leucilla amphora*, H., and *Leucilla capsula*, H., consists in the presence of the subgastric triradiate spicules, the corresponding ones being in these latter forms quadriradiate (Kalkschwämme, Bd. ii. p. 132, and p. 134).

The external form of this Sponge is variable; the specimen from the Bermudas is of irregular outline, presenting a sack 10 mm. wide at the bottom, and 8 mm. broad at the free end, the length of the longitudinal axis being 12 mm. Both the specimens from the Philippine Islands are of tubular elongated form, growing narrower towards both ends, the smaller specimen (the size of the larger could not be measured, its lower end having been broken off) reaching a length of 60 mm. with a maximum diameter of 7 mm., that of the larger specimen being 13 mm. The walls of this latter are 2 mm. thick, those of the smaller specimen 1 mm., those of the specimen from the Bermudas 1·5 mm. In all these specimens the outer surface is roughened by the cortical spicules, the inner surface bristly, owing to the apical rays of the gastric quadriradiate spicules, curved as usual towards the free end of the Sponge.

The specimen from the Bermudas was found to contain spermospores, and more or less developed larvæ (Amphiblastulæ).

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of parenchymal quadriradiate, of dermal quadriradiate spicules (not differing with regard to their form and size from those of the parenchyma), and of fine dermal acerate spicules.

Gastric quadriradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm. on an average), more or less sharply pointed; basal ray straight, length inconstant, varying from 0·25 to 0·35 mm., forming with each of the lateral rays an angle of about 110°; lateral rays curved outwards, reaching a length of 0·4 mm.; apical ray curved, half as long as lateral rays. Towards the osculum these quadriradiate spicules grow smaller (lateral rays 0·3 mm. long, with a diameter of 0·0125 mm.), the concave lateral rays becoming straight and convex.

Subgastric triradiate spicules.—Sagittal, of the form of the corresponding spicules in *Leucilla connexiva*, but marked out by a great variability in the absolute and relative length of their rays; all rays sharp-pointed and of the same diameter, the proportion between their length and thickness varying from 12 : 1 to 20 : 1; length, as above mentioned, inconstant, not exceeding, however, 0·6 mm. in basal, and 0·42 mm. in lateral rays; some are provided with a rudimentary fourth apical ray.

Quadriradiate spicules of the parenchyma and dermis.—All rays of the same diameter, rarely exceeding 0·05 mm.; facial rays usually of the same length, varying from

0·4 (rarely shorter) to 0·6 mm.; basal ray straight, tapering from the base to an approximately sharp point, forming with each of the lateral rays an angle of 105° to 110°; lateral rays either straight or slightly curved inwards, sharp-pointed; apical ray straight, tapering from the base to a sharp point, never projecting from the inner surface, length varying from 0·4 to 1·2 mm.

Dermal acerate spicules.—Straight, fine, linear, sharp-pointed, surface smooth, length not exceeding 0·4 mm., with a diameter of 0·0025 mm.; not numerous; projecting from the outer surface.

Colour.—White and yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms.

Leuconia, Bowerbank.

Leuconidæ with an irregular disposition of the spicules of the parenchyma throughout; with roundish flagellated chambers.

Leuconia multiformis, n. sp. (Pl. I. fig. 8; Pl. II. fig. 1; Pl. VI. figs. 3*a*–3*c*; Pl. VII. figs. 1*a*–1*h*).

There are in the Challenger collection more than fifteen specimens, which, however different with regard to their external shape, are to be all referred to this species; two of the most typical representatives may be seen drawn in their natural size on Pl. I. fig. 8, and Pl. II. fig. 1. The chief character distinguishing this form from all the species of *Leuconia* hitherto known—so far at least as the existing descriptions permit us to form a judgment—is to be found in its subgastric triradiate spicules, which are of the same shape as those in *Amphoriscus* and *Leucilla*. It is for the last time that we meet with this interesting shape, and here in *Leuconia multiformis* they are in most cases so slender, in comparison with other constituent parts of the skeleton of the parenchyma, that their phylogenetic signification seems to be beyond all doubt. At any rate, together with peculiarities in form and size of other spicules of the skeleton, they present a character allowing of a distinct definition of the species.

According to the greater or less predominance of the large acerate, and to the presence or absence of minute acerate spicules, I subdivide the species into three varieties with the following diagnoses :—

Leuconia multiformis, var. *goliath*.

Outer surface naked, acerate spicules either not projecting at all from the cortex or standing isolated at greater or less distances from one another. On the gastric surface triradiate spicules more numerous than quadriradiate.

Leuconia multiformis, var. *capillata*.

Outer surface fur-like; osculum usually fringed with fine linear acerate spicules; gastric skeleton consisting mainly of the quadriradiate form.

Leuconia multiformis, var. *amorpha*.

Gastric skeleton, besides triradiate and quadriradiate, consisting also of minute acerate, spicules, sometimes lying isolated, sometimes filling all the interstices between the triradiate and quadriradiate spicules just mentioned. Outer surface more or less bristly. The minute acerate spicules are occasionally to be found in the parenchyma and on the outer surface too.

One of the specimens belonging to the variety *goliath* attains a length of 233 mm., and is the largest calcareous sponge hitherto known. The external form of the varieties *goliath* and *capillata* is that of an elongated tube; the specimens of the variety *amorpha* in the collection are of irregular outline, rather sac-like. The varieties *amorpha* and *goliath* are from Bermudas, the variety *capillata* from Zebu.

Skeleton.—The skeleton consists of gastric quadriradiate and triradiate, of subgastric triradiate, of quadriradiate and triradiate spicules belonging to the parenchyma, of dermal triradiate, of large acerate, of minute acerate, and of fine linear acerate spicules of the peristome.

Gastric quadriradiate and triradiate spicules.—Basal ray straight, tapering from the base to a sharp point, usually half as long as lateral rays, with a diameter of 0·02 mm.; lateral rays slightly curved inwards, of rather cylindrical form, yet sharply pointed, each forming with basal ray an angle of 100° to 105°, average size 0·45 by 0·015 mm.; apical ray of the same thickness (0·015 mm.), curved, sharply pointed, length varying from 0 to 0·15 mm.

Subgastric triradiate spicules—Sagittal; all rays of the same average diameter (0·035 mm.), smooth, tapering from the base to an approximately sharp point; basal ray straight, its length not exceeding 0·75 mm.; lateral rays undulating, forming with each other an angle varying from 180° to 150°, rarely exceeding 0·45 mm. in length.

Quadriradiate spicules of the parenchyma.—To be found only in the walls of the exhalent canals, too rare to be of any systematic significance; usually of the form and size of gastric quadriradiate spicules, sometimes twice as long and thick, with lateral rays curved outwards; this latter form is connected with the common gastric quadriradiate by intermediate stages.

Triradiate spicules of the parenchyma.—All rays of the same average diameter (0·065 mm.), either lying in the same plane throughout their whole length or bent in such a manner that the plane of the junction of the rays is different from that of their ends; sharp-pointed, rarely longer than 0·7 mm., the comparative length of basal ray being slightly inconstant; some quite regular, the greater part sagittal, the angle formed by basal and each of lateral rays varying from 120° to 110°. There are also in the paren-

chyma spicules of approximately the same dimensions, characterised by a rudiment of the fourth ray, by the undulating lateral rays, and by the comparative length of the basal ray—twice as long as the lateral. I cannot decide whether these are modified triradiate spicules of the parenchyma or of the subgastric region, or quadriradiate spicules of the parenchyma grown considerably larger. They are not numerous.

Dermal triradiate spicules.—Sagittal; all rays in the same plane, either rather cylindrical or tapering from the base to a sharp point; basal ray straight, lateral rays curved outwards, each forming with basal ray an angle of about 120°; absolute length very variable, in most cases lateral rays 0·4 mm.; basal ray 0·3 to 0·4 mm., the proportion between the length and the thickness of the rays being 20 : 1.

Large acerate spicules.—Usually not longer than 6 mm., occasionally reaching 10 mm. (var. *goliath*—immediately under the osculum, projecting from the inner surface), with a diameter never exceeding 0·05 mm.; either spindle-shaped, tapering at either end from the centre to a sharp point, or lanceolate; occasionally of irregular outlines, one end being sharp-pointed, the other truncated or irregularly spherical.

Linear acerate spicules of the peristome.—Attaining a length of over 5 mm., with a diameter of 0·005 mm., either straight or slightly curved.

Minute acerate spicules.—Spindle-shaped, tapering from centre to sharp points, rarely exceeding 0·125 mm. in length, and 0·0025 mm. in diameter.

Colour.—White, cream-white, and dirty yellowish.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Leuconia typica, n. sp. (Pl. VII. figs. 2*a*–2*c*).

The three specimens representing this species in the Challenger collection are to be referred to two varieties with the following diagnoses :—

Leuconia typica, var. *tuba*: tubular, gastric cavity narrow elongated; apical rays of gastric quadriradiate spicules not longer than 0·06 mm., usually still shorter; fine linear acerate spicules reaching 0·3 mm. in length.

Leuconia typica, var. *massa*: lumpy, stout, massive, the longitudinal axis shorter than the transverse; gastric cavity considerably reduced, calyciform; apical rays of gastric quadriradiate reaching 0·1 mm. in length; fine acerate spicules not longer than 0·15 mm.

Both the specimens of the variety *tuba* are 25 mm. long, the average thickness of the walls being 3 mm. The specimen of the variety *massa* is 8 mm. high, 18 mm. broad at its

lower end, and the average thickness of its walls reaches 5 mm. In both varieties the outer and inner surfaces are rough. In its spiculation the species shows a close relation both to *Leuconia multiformis* and to *Leuconia caminus* (*Leucandra caminus* H.), but still the differences are considerable. The main character separating the form in question from *Leuconia multiformis* is the absence of sagittal subgastric triradiate spicules; by its distinctly sagittal dermal triradiate spicules the species can be also very easily distinguised from *Leuconia caminus*.

The round flagellated chambers in this species have particularly regular outlines, and are smaller than in any other case, their diameter rarely exceeding 0·04 mm. In one specimen of the variety *tuba*, I discovered many spermospores, but unfortunately it was not well preserved. The specimen of the variety *massa* proved to be full of Amphiblastulæ.

Skeleton.—The skeleton consists of gastric quadriradiate spicules, quadriradiate spicules of the parenchyma, not differing however, either in form or size, from those of the gastric surface, triradiate spicules of the parenchyma, of dermal triradiate and of parenchymal acerate spicules.

Gastric quadriradiate spicules.—Basal ray straight, tapering from the base to a sharp point usually shorter (0·18 mm.) and rather thinner than lateral rays, forming with each of these latter an angle varying from 105° to 110°; lateral rays more or less cylindrical, either straight or slightly curved forwards, rarely exceeding 0·225 mm. in length, with a diameter of 0·015 mm.; apical ray curved, more or less sharply pointed, in the var. *tuba* wedge-shaped, length not exceeding 0·06 mm., in the var. *massa* reaching 0·1 mm. In both cases, however, the length of the apical ray is variable, and there are amongst the quadriradiate spicules many triradiate spicules also.

Triradiate spicules of the parenchyma.—Most quite regular; rays straight, smooth, tapering from the base to sharp points; reaching 0·75 mm. in length and 0·065 mm. in diameter.

Dermal triradiate spicules.—Sagittal; all rays of the same length, rarely exceeding 0·35 mm., and of the same diameter (0·02 mm.), either tapering from the base to sharp points, or of a more cylindrical form; basal ray straight, lateral rays curved forwards, forming each with basal ray an angle of about 115°.

Acerate spicules.—In the walls of the body (sparsely scattered here and there in the parenchyma, either isolated or in groups) fine, linear, straight, occasionally slightly curved, reaching 0·3 mm. in the variety *tuba*, not exceeding 0·1 mm. in the variety *massa*, diameter 0·001 mm.; near the osculum (var. *tuba*) piercing the wall in perpendicular direction, either spindle-shaped or rather cylindrical, but sharp-pointed, straight or slightly curved, 0·1 mm. long, 0·004 mm. in diameter.

Colour.—Grey and dirty yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas, 32 fathoms; mud.

Leuconia rudifera, n. sp. (Pl. VII. figs. 3*a*-3*c*).

There are in the Challenger collection only some fragments of this interesting species; they seem to belong to two specimens: in one case the walls are 5 mm. thick, in the other not above 3 mm. One fragment bears an osculum fringed with fine linear acerate spicules. Both the surfaces are rough. With regard to its spiculation, the species is intimately allied to *Leuconia typica*, but is distinguished from it, as well as from all other Leuconidæ, by its remarkable minute verticillate acerate spicules (Pl. VII. fig. 3‴).

Skeleton.—The skeleton consists of gastric verticillate acerate, of gastric quadriradiate, of parenchymal triradiate, of dermal triradiate, and of acerate spicules of three different kinds.

Gastric quadriradiate spicules (occasionally to be found also in the walls of the larger exhalent canals).—All rays of the same diameter (0·015 mm.); basal ray usually undulating, rarely longer than 0·2 mm., like lateral rays sometimes sharply, sometimes bluntly pointed; lateral rays either straight or slightly curved, each forming with basal ray an angle varying from 100° to 105°, length not exceeding 0·36 mm.; apical ray curved, tapering from the base to a sharp point, not longer than 0·1 mm., not seldom rather thinner than facial rays.

Verticillate acerate spicules.—I call these spicules acerate, for the transitional stages between them and the common spindle-shaped acerate form can be easily found; these intermediate stages are to be seen on Pl. VII. figs. 3*a*–3*a*‴, and it is evident that the three larger teeth on the free end of these spicules are homologous with the smaller teeth on their middle part. Cylindrical in their free half, which projects from the inner surface, these acerate spicules seem to be flat in their more extended half, situated in the parenchyma; they reach 0·064 mm. in length, and 0·0008 mm. and 0·0014 mm. in diameter.

Triradiate spicules of the parenchyma.—Very inconstant in their outlines, either regular, or sagittal, or irregular. The typical fundamental form can be characterised as follows:—regular; rays tapering from the base to sharp points, 0·35 mm. in length, with a diameter of 0·034 mm. Such triradiate spicules are really to be found, but usually they undergo more or less considerable modifications, either in the direction of a sagittal differentiation, the basal ray growing rather longer than the lateral, and its angles varying from 120° to 110°, or in the direction of an irregular differentiation, all the rays or all the angles growing more or less unequal. In most cases the rays are sharp-pointed.

Dermal triradiate spicules.—All rays of the same diameter, the proportion between their length and thickness varying from 17:1 to 23:1; basal ray straight, tapering from the base to an approximately sharp point, forming with each lateral ray an angle of about 115°, length not exceeding 0·35 mm.; lateral rays curved, often undulating, usually of the length of basal ray, sometimes rather shorter or longer. In two cases I could discern in the dermal triradiate spicules an incipient apical ray.

Acerate spicules.—Of three kinds. *Large acerate spicules of the parenchyma.*—Straight, probably exceeding 2·5 mm. in length, with a diameter of 0·06 mm., projecting from outer surface. They are extremely rare, and having always found them with the free end broken off, I can give no more precise statements as to their length. *Small acerate spicules of the parenchyma.*—Also rare, sparsely scattered here and there in the parenchyma near the outer surface, either in small heaps or isolated, usually situated perpendicularly to the surface, often showing no order in their disposition; average size: 0·3 mm. by 0·0025 mm. *Linear acerate spicules of the peristome.*—Fine, smooth, either straight or slightly curved, sharp-pointed, reaching 3 mm. in length and 0·005 mm. in diameter, often still thinner.

Colour.—Pale yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms; mud.

Leuconia levis, n. sp. (Pl. VII. figs. 4*a*–4*d*).

The two specimens of the Challenger collection for which I establish this new species present elongated thin-walled tubes almost of the same diameter throughout their whole length, and only growing narrower close to the lower end like a wedge. The larger specimen is 50 mm. long, 7 mm. thick; the thickness of the walls is about 0·75 mm. The outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The chief character of the species consists in the slenderness of its spicules. This is also common to *Leuconia fistulosa*, Bk., and *Leuconia pumila*, Bk., yet the size of the spicules, their form and their disposition, distinguish *Leuconia levis* from *Leuconia pumila*; on the other hand, the absence of the acerate spicules and the comparative shortness of the apical ray of the gastric quadriradiate spicules do not allow us to unite this form with *Leuconia fistulosa*, the rays of whose spicules are still more slender.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric quadriradiate, of parenchymal triradiate, and of dermal triradiate spicules.

Gastric quadriradiate spicules.—All rays of the same average diameter of 0·015 mm.; facial rays cylindrical, either sharply or bluntly pointed, apical ray tapering from the base to a sharp point; basal ray straight, forming with each lateral ray an angle of 118°, usually twice as long as lateral rays, often still longer, not exceeding, however, 0·45 mm.; occasionally rather shorter; lateral rays either straight or slightly curved, often rather undulating, their average size 0·175 mm.; apical ray curved, rarely longer than 0·09 mm.

Subgastric quadriradiate spicules (lateral and apical rays in the plane of the gastric surface, basal ray directed centrifugally).—All rays smooth, tapering from the base to sharp points; facial rays of the same average diameter (0·0125 mm.); apical ray rather thinner; basal ray straight, usually 0·3 mm. long, forming with each of lateral rays an angle varying

from 110° to 115°; lateral rays undulating, forming one with the other an angle of about 170°; apical ray curved, rarely longer than 0·1 mm. These quadriradiate spicules are connected by intermediate stages with the larger triradiate spicules of the parenchyma, which are furnished also here and there with short apical rays.

Triradiate spicules of the parenchyma.—Of two kinds; larger, sagittal, their basal ray in most cases directed centrifugally, and smaller, either regular or sagittal or irregular, scattered in the parenchyma without any order. *Larger triradiate spicules.*—All rays in the same plane and of the same diameter (0·015 mm.), occasionally rather thicker; basal ray straight, like lateral rays tapering from the base to a sharp point, length 0·38 mm. on the average; lateral rays either straight or more or less curved, often undulating, each forming with basal ray an angle varying from 115° to 125°, average length 0·2 mm. *Smaller triradiate spicules.*—Form variable (Pl. VII. fig. 4*d*–4*d*‴); length of rays not exceeding 0·075 mm., the proportion between the thickness and the length being 1 : 10; not numerous.

Dermal triradiate spicules.—Of exactly the same size and form as the larger triradiate spicules of the parenchyma, the only distinction being that the angle between basal and each lateral ray is more constant (120°), and that the lateral rays are usually neither straight nor undulating, but slightly curved.

Colour.—Dirty yellowish.

Habitat.—Station 145, December 27, 1873; lat. 46° 40′ S., long. 37° 50′ E.; off Prince Edward Islands; depth, 150 fathoms.

Leuconia crucifera, n. sp. (Pl. VII. figs. 5*a*–5*d*).

This species is represented in the Challenger collection by a single fragment belonging to the inferior part of the animal. The fragment is of compressed form, 10 mm. long, with a maximum diameter of 8 mm. The thickness of the walls is 0·8 mm. The outer surface is bristly, the inner surface slightly roughened by the apical rays of the gastric quadriradiate spicules. These are all more or less cruciform, all the rays lying in the same or almost in the same plane. By this character the species can be very easily distinguished from all other Leuconidæ. There are indeed some forms which, like *Leuconia nivea*, *Leuconia johnstonii*, &c., possess cruciform quadriradiate spicules also; but in these species these are always minute, while here in *Leuconia crucifera*, on the contrary, they are of considerable size.

Leuconia crucifera and *Leucosolenia blanca* are of particular interest as forms inhabiting the greatest depth (450 fathoms) from which Calcarea have been hitherto obtained.

Skeleton.—The skeleton consists of gastric quadriradiate, of parenchymal triradiate, of dermal triradiate, and of stout acerate spicules, piercing the parenchyma obliquely, and projecting with their free end from the outer surface, and of slender acerate spicules, scattered here and there on the outer surface in small bundles.

Gastric quadriradiate spicules.—Basal ray centrifugally, apical ray centripetally directed, lateral rays lying parallel to the inner surface; all rays of the same average diameter (0·015 mm.), lying in the same or almost in the same plane; basal ray straight, tapering from the base to a sharp point, forming with each of lateral rays an angle varying from 96° to 100°, average length 0·25 mm.; lateral rays straight, occasionally slightly curved, either cylindrical or tapering from the base to approximately sharp points, usual length 0·2 mm.; apical ray straight, cylindrical, bluntly pointed, forming with basal ray an angle varying from 180° to 165°, of the same length as the lateral rays, often rather shorter and thinner.

Triradiate spicules of the parenchyma.—Sagittal; always of the same average diameter (0·018 mm.), usually tapering from the base to sharp points, forming three angles of 120°; basal ray straight, reaching 0·3 mm. in length, often shorter (0·2 mm.); lateral rays curved forwards, their average length 0·2 mm.; many of them show a rudiment of the fourth ray, occasionally reaching 0·1 mm. in length, which, like that of the gastric quadriradiate spicules, lies almost in the same plane as the facial rays, being, however, always sharp-pointed.

Dermal triradiate spicules.—Of the size and form of the triradiate spicules of the parenchyma, the only distinction being that the angles formed by basal and lateral rays, which are in the last named spicules usually of 120°, and if varying showing an inclination to grow more acute, here in the dermal triradiate spicules show on the contrary an inclination to grow more obtuse, varying from 120° to 125°.

Stout acerate spicules.—Spindle-shaped, either straight or slightly curved, reaching 3 mm. and more in length, the average proportion between the length and thickness being 30:1; piercing the parenchyma in an oblique direction, the oral angle formed by them and the longitudinal axis of the Sponge varying from 60° to 45°.

Slender acerate spicules.—Either spindle-shaped or more or less cylindrical, straight; surface either smooth or rather rough; average size, 0·8 mm. by 0·0025 mm.

Colour.—Dirty white.

Habitat.—Station 75, July 2, 1873; lat. 38° 37′ N., long. 28° 30′ W.; off the Azores; depth, 450 fathoms; sand.

Leuconia ovata, n. sp.

I have already taken occasion to express in this paper[1] my assurance that the genus *Leuconia*, as I restricted it, is a temporary one, and that its subdivision into many quite independent genera can be predicted. The statement was also made, that one of these conjectural genera will embrace forms like *Leuconia saccharata*, H., *Leuconia ochotensis*, M.M., &c. The name of this new genus would be—according to the law of priority—*Baeria*, Miklucho-Maclay, and its chief characters a strongly developed cortex

[1] Page 28.

and a predominance of minute acerate spicules. From this point of view the species I am going to describe is of particular interest. In the main features of its organisation it does not differ from *Leuconia multiformis*, *Leuconia typica*, &c., its cortical layer being represented by a thin dermal membrane; but its spicular characters are so strikingly similar to those of *Leuconia* (*Baeria*) *saccharata*, H.,[1] that a close parentage of both these forms is evident; and *Leuconia saccharata*, even in spite of its, I must add, very doubtful subdermal cavities, is one of the most typical representatives of our conjectural genus.

Leuconia ovata is represented in the Challenger collection by one specimen from Christmas Harbour. The specimen is of ovoid form, yet rather compressed, 30 mm. long., 18 mm. broad in the middle, its walls 4–5 mm. thick, in the interior half growing gradually thinner towards the free end. Both the surfaces are smooth. As I remarked before, no deviations are to be noticed with respect to the internal organisation; as in most Leucones, the flagellated chambers are of roundish outline, their diameter 0·06 mm. on an average, the pores and vents (gastric openings) of variable size and irregularly disposed. The specimen proved to be sterile.

Skeleton.—The skeleton consists of minute acerate spicules, coating the gastric and dermal surfaces, of gastric triradiate, of parenchymal triradiate, and of dermal triradiate and quadriradiate spicules.

Minute acerate spicules.—Some of these are just of the same form, and most of the same dimensions, as the corresponding ones in *Leuconia saccharata*, every spicule being composed of two parts—of a shorter spiny and of a longer smooth; but while *Leuconia saccharata* is, according to Hæckel, quite constant to this characteristic form of its minute acerate spicules, those in *Leuconia ovata* show a considerable variability; sometimes they are spiny on their whole surface, sometimes, on the contrary, they are smooth in both their parts, sometimes the shorter is smooth and the longer spiny. Also, with respect to the angle formed by their longer and shorter parts, these acerate spicules are inconstant, there being amongst them all possible intermediate stages between such spicules as drawn by Hæckel for his *Leucandra saccharata* (*loc. cit.*, pl. xxxviii. fig. 13) and common spindle-shaped acerate spicules. Characteristic of both surfaces, the minute acerate spicules lie in the parenchyma perpendicular to the longitudinal axis of the Sponge, the shorter spiny ends of the dermal acerate spicules being directed centrifugally, those of the gastric spicules centripetally.

Gastric triradiate spicules.—These are also of the form and size of the corresponding spicules of *Leuconia saccharata*, but more variable with respect to the length of their rays, that of the lateral varying from 0·15 mm. to 0·3 mm., that of the basal ray from 0·08 mm. to 0·2 mm. In most cases the basal ray is $\frac{1}{2}$–$\frac{3}{4}$ as long as the lateral, but occasionally its length reaches, and even surpasses, that of the lateral. Some of them—not many—are provided with a short (0·02 mm. to 0·08 mm.) apical ray. The basal ray of the gastric triradiate spicules

[1] Kalkschwämme, Bd. ii. p. 229, Bd. iii. pl. xxxiii. figs. 3*a*–3*e*, pl. xxxviii. fig. 13.

is directed towards the closed end of the animal, and only near the gastric openings their disposition becomes irregular.

Triradiate spicules of the parenchyma.—Like those in *Leuconia saccharata* in most cases regular, but with rays not exceeding 0·45 mm. in length, usually still shorter (0·3 mm. and less). In the first case the proportion between the length and the thickness of the rays is like *Leuconia saccharata* 10:1; the rays of the smaller spicules are more slender, the corresponding proportion varying from 12:1 to 20:1. The sagittally and irregularly differentiated triradiate spicules of the parenchyma are too rare to be of any systematic significance.

Dermal triradiate spicules.—Not differing from those of the parenchyma, and showing the same variations with respect to size and slenderness, with only this distinction that the cases of sagittal differentiation—the lateral rays growing more or less curved forwards—are more numerous.

Dermal quadriradiate spicules.—Rare. Sagittal; basal and centripetally directed apical ray straight, lateral rays curved forwards, often undulating; all rays tapering from the base to approximately sharp points, rarely longer than 0·4 mm., with a diameter of 0·03 mm. to 0·04 mm.

Colour.—Violet-greyish.
Habitat.—Station 149, off Kerguelen Island; January 29, 1874; depth, 70 fathoms.

Leuconia loricata, n. sp. (Pl. II. fig. 2; Pl. VII. figs. 6*a*–6*b*).

The chief characters of this species, represented in the Challenger collection by a single specimen, 30 mm. long. and 8 mm. broad, are the following:—(1) a strongly-developed cortex 0·5 mm. thick, the width of the whole wall being 2 mm., consisting of several parallel layers of sagittal triradiate spicules; (2) a quite irregular disposition of the parenchymal spicules, only those which are near the inner surface lying more or less parallel to it; (3) minute spined acerate spicules scattered everywhere in the body, but chiefly coating the inner surface. The structure of the canal system presents no deviations from the general type.

Skeleton.—The skeleton consists of minute spined acerate spicules, of triradiate spicules of the parenchyma, of cortical triradiate, of cortical stout and linear acerate, and of acerate spicules of the peristome.

Spined acerate spicules.—The modifications of their form, and the intermediate stages between them and common spindle-shaped minute acerate spicules, although rare in *Leuconia loricata* yet still to be found, are given on Pl. VII. fig. 6*a*–6*a*''''. Their average length is 0·025 mm., with a diameter of 0·002 mm. Numerous on the inner surface, they are very rare in the parenchyma and in the cortex.

Triradiate spicules of the parenchyma.—Either quite regular or rather sagittal and irregular; rays straight, tapering from the base to sharp points; surface more or less smooth; the proportion between the length and thickness 8:1; the length, 0·6–1 mm.

Cortical triradiate spicules.—Sagittal; all rays lying in the same plane, tapering from the base to a more or less rounded end, usually of the same thickness, the proportion between this latter and the length varying from 10:1 to 16:1; basal ray straight, sometimes rather thinner than lateral rays, forming with each of these latter an angle of 115°; lateral rays either straight or slightly curved forwards, 0·325–0·5 mm. long, usually somewhat shorter than basal ray, often of the same length, sometimes even rather longer. In the wall of the collar these triradiate spicules become smaller, their rays being rarely longer than 0·15 mm., with a diameter of 0·0125 mm., and show a regular disposition, their basal ray being directed towards the closed end of the animal.

Stout acerate spicules.—Sparsely scattered in the wall perpendicularly to the outer surface, often projecting from it; spindle-shaped, tapering from the centre to a sharp point at each side, either straight or slightly curved; rarely exceeding 0·75 mm. in length and 0·04 mm. in diameter.

Slender acerate spicules of the same shape as and disposed similarly to the last-mentioned form, rarely longer than 0·3 mm. with a diameter of 0·0025 mm.

Acerate spicules of the collar straight or curved, either sharply or bluntly pointed; 0·5–1 mm. long, and 0·018 mm. in diameter.

Colour.—Pale yellowish.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Leuconia fruticosa, Hæckel, sp. (Pl. II. fig. 4).

Sycothamnus fruticosus, H., Prodromus, p. 240.
Lipostomella clausa, H., Prodromus, p. 249.
Leucetta primigenia, H., Kalkschwämme, Bd. ii. p. 118.

This species is represented in the Challenger collection by three specimens of somewhat Asconoid aspect, owing to the considerable reduction of the inner cavity (Pl. II. fig. 4). Each specimen is provided with an osculum, surrounded in all three cases with a collar, while all the specimens examined by Prof. Hæckel were either mouthless or bare-mouthed. Two specimens are pear-shaped, the larger attaining a length of 23 mm. and a diameter of 19 mm.; the third is of quite irregular outline, rather resembling an incrustation, the thickness of the body exceeding, however, 5 mm. in its narrowest part. The measurements agree closely with those given by Hæckel for his variety *isoraphis*. In two specimens (from Balfour Bay) the triradiate spicules are all of the same size (0·15 mm. long), the proportion between the length and the thickness of the rays being 12:1, and the rays of conical form. In the specimen from Station 150 the majority of the spicules

are also 0·15 mm. long, but there are, moreover, chiefly on the outer surface, spicules reaching 0·2 mm. in length; in both cases the proportion between the length and the thickness of the rays being 15 : 1, and the rays of rather cylindrical form. According to his theoretical speculations, Hæckel gave to the species in his Monograph another name. We know, however, that the speculations alluded to have no real foundation, and therefore I propose to return to the older specific name of the Sponge in question.

Colour.—Dirty yellowish.

Habitat.—Station 149, Balfour Bay, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms. Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; near Heard Island; depth, 150 fathoms; rock.

Leuconia dura, n. sp. (Pl. II. fig. 3; Pl. VII. figs. 7*a*–7*a*‴).

This species is represented in the collection by many colonial and solitary forms from the Bermudas, and by one colonial specimen from Australia. This latter may be seen drawn in its natural size on Pl. II. fig. 3. All the specimens are either bare-mouthed or provided with a collar, and their inner cavity is either still distinguishable, although more or less short and narrow, or reduced (Australian specimen) to a small hollow space just under the osculum. The skeleton consists principally of large and small regular triradiate spicules, the latter showing occasionally the rudiment of the fourth ray (Australian specimen). The measurements of these smaller and larger regular triradiate spicules agree closely with those given by Hæckel for his *Leucetta primigenia*, var. *microraphis* (specimen from Bermudas), and var. *megaraphis* (specimen from Australia). There are, however, two distinctions: in *Leuconia dura*, in company with the regular spicules, are also others, which, although of the same dimensions as the smaller regular triradiate spicules, are yet either sagittally, or sometimes, though not often, irregularly differentiated. These chiefly sagittal spicules are to be found only in the region of the osculum; they prove, consequently, the permanence of the presence of this latter, and this forms the second difference, the varieties of *Leuconia fruticosa* being, according to Hæckel, sometimes furnished with oscula, sometimes mouthless. The spicules in question are represented on Pl. VII. fig. 7; they have, apart from their size, just the same form as the corresponding triradiate spicules of *Leucosolenia poterium* (?), *Leucetta vera*, and *Leucetta hæckeliana*. We learn from this coincidence that the horn-shaped form of spicule is very well adapted for constituting the skeleton of the borders of the osculum or of the membrana oscularis. It is not, however, always the case. The corresponding spicules in *Leuconia fruticosa* just described show no difference in their form from the other spicules of the sponge, and as the regular triradiate spicules are comparatively very constant in their outlines, I think I am right in concluding that their local differentiation into

sagittal ones in my *Leuconia dura* proves the constancy in the presence of the osculum, and thus justifies the establishment of a new species.

Colour.—Yellowish and greyish.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 186, September 8, 1874; lat. 10° 30′ S., long. 142 -18′ E.; Torres Strait, Australia; depth, 8 fathoms; coral sand.

Pericharax, n. gen.

Leuconidæ with distinct subdermal cavities.

Pericharax carteri,[1] n. sp. (Pl. II. fig. 5; Pl. VII. fig. 8).

The species is represented in the collection by a whole specimen and a fragment of another. The first is shown on Pl. II. fig. 5. It reaches 40 mm. in length, with a maximum diameter of 22 mm., the thickness of the walls being 5 mm., in the second specimen not exceeding 3 mm. The outer surface is smooth, the inner roughened by the apical rays of the gastric quadriradiate spicules. From *Pericharax cucumis* (*Leucandra cucumis*, H.—Kalkschwämme, ii. p. 205) the species can be distinguished by the following characters:—1, the skeleton of the parenchyma and of the subdermal cavities consists not of quadriradiate but of triradiate spicules; 2, the subdermal spicules are not larger than those of the parenchyma, but equal to some of these and smaller as compared with others.

The species itself is to be subdivided into two varieties; the gastric spicules and those of the parenchyma are of the same size and form in both specimens, but in one the skeleton of the subdermal cavities consists of regular triradiate spicules, not differing from the smaller spicules of the parenchyma, in the other of sagittal and irregular triradiate spicules, although of the size of the smaller triradiate spicules of the parenchyma, yet of a different form. The first variety may be named "*homoraphis*," the second "*heteroraphis*." In both these varieties the "gastric ostia" are very large, their diameter reaching 0·75 mm. The exhalent canals are also of considerable dimensions, their surface almost in all their length being armed with quadriradiate spicules.

One specimen, var. *homoraphis*, proved to be sterile, in the other I found ova of an extraordinary size, their diameter being 0·3 mm. on an average.

Skeleton.—The skeleton consists of regular gastric quadriradiate spicules, following the course of the invaginations of the inner cavity; of larger and smaller regular triradiate spicules of the parenchyma, and of dermal triradiate spicules, as well as of those of the subdermal cavities, regular in one variety, sagittal and irregular in the other.

[1] I dedicate this species to Mr. H. J. Carter, F.R.S., as a token of my deep respect for his scientific labours.

Gastric quadriradiate spicules.—Regular, facial rays straight, smooth, tapering from the base to approximately sharp points, their average length being 0·15 mm., and their diameter 0·01–0·013 mm.; apical ray of the same diameter, sharp-pointed, either straight or curved, often irregularly bent; sometimes very short, rudimentary, usually 0·2–0·25 mm. long.

Triradiate spicules of the parenchyma.—The greater part of these consists of spicules not differing from the quadriradiate ones just described, except in the absence of the fourth ray; amongst them are scattered here and there much larger triradiate spicules, which differ from them only in size. The rays of these larger triradiate forms sometimes exceed 1 mm. in length, the proportion between the length and thickness varying from 10:1 to 12:1; they are connected with the smaller triradiate variety by intermediate stages.

Dermal and subdermal triradiate spicules.—In the variety *homoraphis* these do not differ, either in their size or in their form, from the smaller triradiate ones of the parenchyma; in the variety *heteroraphis* they remain of the same size, but become sagittal and irregular. Their typical modifications are represented on Pl. VII. fig. 8. They form in this variety also the skeleton of the collar; the fragment of the var. *homoraphis* I possess has its oscular part broken off.

Colour.—Greyish.

Habitat.—Station 135, October 1873; Island of Tristan da Cunha; depth, 60 fathoms; rock, shells.

Leucetta, Hæckel.

Leuconidæ, the skeleton of whose strongly developed cortex is quite different from that of the parenchyma.

Leucetta imperfecta, n. sp. (Pl. VII. figs. 9*a*–9*e*).

This species, like the following, *Leucetta vera*, is represented in the Challenger collection by a single specimen, which is bare-mouthed, of tubular, elongated, cylindrical form, 35 mm. long and 5 mm. in diameter, the thickness of the wall being 1·25 mm., that of the cortex 0·35 mm. Both the surfaces are rather rough. The characteristic peculiarities of the species consist in the form of its pigmy triradiate, and in the presence in the parenchyma of large quadriradiate spicules, not differing either in size or in form from those of the cortex; these last are not numerous, but they are there, and most of them having just the same disposition as the large subgastric quadriradiate spicules in *Leucilla amphora*, H. (Kalkschwämme, iii. pl. xxiv. fig. 8), the species may be regarded as a connecting link between the genera *Leucetta* and *Leucilla*.

Skeleton.—The skeleton consists of minute gastric quadriradiate, of minute triradiate and quadriradiate and of large quadriradiate spicules of the parenchyma; of cortical triradiate spicules lying in several layers parallel to the outer surface, and of cortical quadriradiate spicules, their facial rays lying in the cortex parallel to the cortical triradiate

spicules, and their apical ray, the free end of which only exceptionally projects from the inner surface, piercing the parenchyma in a centripetal direction.

Gastric quadriradiate spicules.—All more or less regular; facial rays straight, smooth, tapering from the base to approximately sharp points, 0·06 mm. long, diameter varying from 0·006 mm. to 0·008 mm.; apical ray either straight or curved, often irregularly bent, sharply pointed; length inconstant, reaching 0·08 mm.

Minute quadriradiate and triradiate spicules of the parenchyma.—Quadriradiate just of the same form and dimensions as those of the gastric surface, not numerous; triradiate still smaller, their rays rarely exceeding 0·025 mm. in length, and 0·002 mm. in diameter; some of them are regular, their straight and smooth rays tapering from the base to sharp points; but such regular triradiate forms are extremely rare; most present only two rays, forming an angle varying from 120° to 160°, the basal ray having become rudimentary, and being represented only by a small process at the crossing of the lateral rays.

Quadriradiate spicules of the parenchyma and cortex.—Both of the same form and the same very inconstant dimensions, the length of their rays varying from 0·3 mm. to 1 mm., and even more. Regular; rays smooth, tapering from the base to sharp points, usually ten times as long as thick.

Dermal triradiate spicules.—Like the quadriradiate just described, regular, but more inconstant with respect to the proportion of the length of their rays to their thickness; this proportion varies from 10:1 to 16:1. Rays smooth, of conical or cylindrical form, bluntly pointed; average length, 0·6 mm.

Colour.—Yellowish.

Habitat.—Station 163 A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Leucetta vera, n. sp. (Pl. VIII. figs. 7–10).

The specimen representing this species in the Challenger collection is of tubular form, about 40 mm. long and 7 mm. broad in its superior half, the inferior half presenting a kind of peduncle 3 mm. in diameter; the peduncle does not, however, differ anatomically from the superior part of the animal. The osculum is surrounded by a low collar; the outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The thickness of the wall differs in different parts of the body, varying from 1 to 2·6 mm.; that of the cortex is more constant (0·4 mm. to 0·5 mm.). The structure of the canal system is very peculiar, the differences in the size and form of the flagellated chambers being in no other case so striking as here. In the peduncle and in the gastric half of the superior part of the body the flagellated chambers are, although very variable in size, at least all more or less regularly round. On the contrary, near the cortex they are elongated, cylindrical, very similar to the radial tubes of the Syconidæ, and, following their course, the inhalent canals become elongated and tubular also (fig. 7). The exhalent canals—occasionally also the inhalent—are in their turn characterised by

an interesting peculiarity in the histological character of the pavement cells of their surface, these cells, as well as the granules of their protoplasm, being here incomparably larger than usual (fig. 8). Of the generative products I found in the specimen only young ova. In its spiculation the species shows a great affinity to *Leucetta clathria* H. (sp.), but the form and dimensions of the spicules of the parenchyma are so very different, that the establishment of a new species is necessary.

Skeleton.—The skeleton consists of gastric and parenchymal quadriradiate, of cortical quadriradiate spicules, disposed like those in *Leucetta imperfecta*, and of cortical triradiate spicules.

Gastric and parenchymal quadriradiate spicules.—Usually regular; rays smooth, tapering from base to approximately sharp points, facial rays straight, apical ray either straight or undulating, length varying from 0·05 mm. to 0·1 mm., the proportion between the length and the thickness being 10 : 1. Some of them occasionally become sagittal, the angle between the basal and each of the lateral rays becoming more acute; in the parenchyma such sagittal quadriradiate spicules show an inclination to lose their apical ray.

Cortical quadriradiate spicules.—Regular or sagittal, the angle between basal and lateral rays varying from 120° to 112°; all rays smooth, tapering from the base to sharp points, the proportion between the length and the thickness being 10 : 1; basal and apical rays straight; lateral rays either straight or slightly curved; facial rays rarely longer than 0·8 mm., length of the apical ray inconstant, varying from 0·6 mm. to 2 mm., its free end projecting occasionally from the inner surface.

Cortical triradiate spicules.—Regular; rays conical, tapering from base to sharp points, 0·45 mm. long, with a diameter of 0·0375 mm.; near the osculum these triradiate spicules become smaller and sagittally differentiated, adopting the form of the oscular triradiate spicules of *Leucosolenia poterium* (?), *Leuconia dura*, &c.

Colour.—Greyish.

Habitat.—Off Kerguelen, January 1874; depth, 10 to 100 fathoms.

Leucetta hæckeliana, n. sp. (Pl. II. fig. 6; Pl. VIII. figs. 1–6).

This species, which I dedicate to the illustrious author of the Kalkschwämme, shows, like *Leucetta vera*, a very close relation to *Leucetta clathria*, H., but the differences in spiculation are still considerable enough to separate these two forms into different species. The cortical quadriradiate spicules are in *Leucetta hæckeliana* strikingly rare, their apical ray never projects with its free end from the outer surface; the gastric and parenchymal quadriradiate spicules are, although similar in size to those in *Leucetta clathria*, yet of quite different outline, and finally, *Leucetta clathria* was found in the form of a mouthless colony (Kalkschwämme, ii. p. 159), while all the specimens of my *Leucetta hæckeliana* are provided with an osculum, the collar of which possesess its own skeleton, different from those of the cortex and of the parenchyma. Three individuals of this

pecies are represented on Pl. II. fig. 6. The largest of them reaches 65 mm. in length, with a maximum diameter of 10 mm.; the walls are 2·5 mm. to 3 mm. thick, the cortex strongly developed. The outer surface is smooth, the inner slightly rough.

Skeleton.—The skeleton consists of gastric and parenchymal quadriradiate spicules, and of dermal triradiate and quadriradiate spicules.

Gastric and parenchymal quadriradiate spicules.—Either regular or sagittal, the lateral rays becoming more or less curved, or even irregular, all rays instead of being straight, becoming irregularly bent and of different lengths; all rays of the same average diameter (0·005 mm.), tapering from the base to sharp points; facial rays 0·02 mm. long, the length of the apical ray inconstant, varying from 0·02 mm. to 0·08 mm. The gastric quadriradiate spicules follow the course of the exhalent canals throughout their whole length, and their presence or absence on the surface of the cavities of the parenchyma shows whether we have to do with an exhalent or inhalent canal system.

Dermal quadriradiate spicules.—Extraordinarily rare; regular; all rays of the same length, not exceeding 0·75 mm. by 0·075 mm., smooth, tapering from the base to sharp points.

Dermal triradiate spicules.—Regular, rays of a rather cylindrical form, 0·55 mm. long, 0·03 mm. in diameter, lying in the cortex in several parallel layers, becoming smaller in the low collar and sagittally differentiated, the angles between basal and lateral rays becoming more acute (120°–95°), and the lateral rays themselves, like those in the oscular triradiate spicules of *Leucetta vera* becoming horn-shaped.

Colour.—Cream white.

Habitat.—Station 163A, June 3, 1874, off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Family TEICHONIDÆ (Teichonia, Teichonellidæ), Carter.

Heterocœla with outer surface differentiated into two different planes, one bearing pores, the other oscula.

Eilhardia, n. gen.

Teichonidæ of calyciform shape. The surface carrying pores supported by triradiate and minute acerate spicules, that bearing oscula propped by large acerate spicules.

In honour of the naturalist whose extensive and precise investigations have marked a new era in Spongiology, I name this genus *Eilhardia*, and the single species of the genus at present known *schulzei*.

Eilhardia schulzei, n. sp. (Pl. II. fig. 7; Pl. IX. figs. 1–10).

This form is doubtless the most beautiful of all the calcareous Sponges hitherto known. The shape of its body is calyciform, the concave surface is dull, the convex has a silvery

lustre. The convex surface bears low volcano-like oscula, disposed at approximately equal distances one from another; their diameter does not exceed 0·4 mm., usually being still less. The concave surface may be compared to a sieve, its pores, inconspicuous to the naked eye, are found under the microscope to be round and disposed close together; their average diameter is 0·06 mm. (Pl. IX. fig. 3). The walls of the calyx, 3 mm. to 4 mm. thick near the centre, grow gradually thinner to its free blade-like margin.

The species is represented in the collection by two complete specimens, one young, 7 mm. broad, 4·5 mm. high, with but few oscula; the other of considerably larger size (the longer diameter of the calyx 35 mm., the shorter 22 mm., the height 20 mm.), and by a fragment belonging apparently to a specimen of still larger dimensions. The larger complete specimen is represented on Pl. II. fig. 7.

The internal organisation (Pl. IX. fig. 1) does not differ from that of Leuconidæ.

Skeleton.—The skeleton of the sieve-like surface consists of sagittal triradiate and minute acerate spicules; that of the parenchyma of large regular, often sagittal triradiate, and of minute acerate spicules; that of the convex oscular surface of large acerate and subdermal triradiate; that of the oscula themselves of an exterior layer of large acerate, of a middle layer of sagittal triradiate, of an inner layer of quadriradiate, and of minute acerate spicules, supporting the ring-like border at the external opening of the osculum (Pl. IX. fig. 2). The minute acerate spicules are in all parts of the body of the Sponge of the same outline.

Minute acerate spicules.—The most typical variations are given on Pl. X. fig. 10. Usually 0·05 mm. long, with a diameter of 0·0025 mm.

Triradiate spicules of the sieve-like surface.—Sagittal; all rays lying in the same plane, of the same diameter, tapering from the base to approximately sharp points; lateral rays curved forwards, slightly undulating, each forming with basal ray an angle varying from 115° to 120°, reaching 0·75 mm. in length (usually not longer than 0·5 mm., often still shorter), the proportion between the length and the thickness being 15 : 1; basal ray straight, length inconstant, either rather exceeding that of lateral rays or equal to it, or even shorter.

Triradiate spicules of the parenchyma.—Regular, with pronounced inclination to sagittal differentiation by the shortening of basal ray; all rays of the same diameter, the proportion between their length and thickness varying (in lateral rays) from 10 : 1 to 12 : 1; lateral rays smooth, tapering from the base to sharp points; basal ray, if not shortened, also sharp-pointed, if shortened, often truncated, in both cases, however, of conical form; size extremely inconstant, the length varying (in lateral rays) from 0·15 mm. to 1·8 mm. In two cases I found these triradiate spicules showing a rudimentary fourth apical ray.

Subdermal triradiate spicules of the convex surface.—Sagittal; all rays lying in the same plane; basal ray straight, tapering from the base to a sharp point, $\frac{1}{2}$–$\frac{3}{4}$ as thick as lateral rays and either longer than these latter (not more than twice, however), or of the same length, or even shorter, forming with each of them an angle varying from 110° to 115°; lateral rays either straight, or slightly curved, average length 0·6 mm., the proportion between

the thickness and the length varying from 1 : 10 to 1 : 12. In the spaces between the oscula these triradiate spicules lie pretty regularly, their corresponding rays being disposed more or less parallel one to another, their basal ray turned to the closed end of the Sponge, and the angle between the lateral rays towards the sharp margin dividing the sieve-like surface from that bearing oscula. Near these latter, as well as near the margin just mentioned, their disposition becomes irregular, they lose their characteristic shape, presenting all possible transition-forms to the sagittal triradiate spicules of the sieve-like surface, and, on the other hand, growing smaller, to the rectangular triradiate ones of the oscular skeleton.

Large acerate spicules of the convex surface.—Lying in several layers almost parallel to the surface, causing its smoothness and silvery lustre. Form, length, and comparative thickness extremely variable, either spindle-, club-, or lance-shaped, or of quite irregular outline, reaching 1 mm. in length (usually shorter), the proportion between their length and thickness varying from 8 : 1 to 30 : 1.

Oscular acerate spicules.—Spindle- or lance-shaped, usually twenty-eight times as long as thick rarely longer than 0·55 mm., often considerably shorter.

Oscular triradiate spicules.—Sagittal, basal ray forming with each of lateral rays an angle of 90 ; basal ray straight, tapering from the base to a sharp point, usually half as thick as lateral rays, often still thinner, occasionally almost of the same diameter; length inconstant, rarely longer than 0·05 mm., often not exceeding 0·01 mm. or still shorter ; lateral rays either straight, or slightly curved inwards, usually sharply pointed, ten times as long as thick, average length 0·1 mm. ; connected as regards their form and size with the sagittal subdermal triradiate spicules of the oscular surface by a long series of intermediate stages.

Oscular quadriradiate spicules.—Like the rectangular triradiate, nothing but modified sagittal triradiate spicules of the oscular surface ; lateral rays either straight or slightly curved forwards, tapering from the base to approximately sharp points, average length 0·2 mm. by 0·02 mm., basal ray usually rather shorter, straight, sharp-pointed, forming with each of lateral rays an angle of about 110°; apical ray curved, not seldom undulating, sharp-pointed like the facial rays, usually rather thinner than these latter ; length varying from 0·06 to 0·2 mm.

Colour.—White.

Habitat.—Station 163A, June 3, 1874, off Port Jackson ; depth, 30 to 35 fathoms ; rock. Station 163, April 4, 1874 ; lat. 36° 56′ S., long. 150° 30′ E.; depth, 120 fathoms ; off Twofold Bay, Australia.

In order to render conspicuous the comparative richness of the Challenger Stations in Calcarea, I give here the following Table, showing also the depths from which the Sponges were dredged.

	Bermudas.	Azores.	Cape de Verde Islands.	Bahia.	Tristan da Cunha.	East of Prince Edward Island.	Kerguelen Island.	Eastern Coast of Australia.				Philippine Islands.
								Bass Strait.	Twofold Bay.	Port Jackson.	Torres Straits.	
Leucosolenia poterium (?),	...	...	...	...	...	...	...	...	120	30–35	...	...
lamarckii,	...	...	...	...	...	...	...	...	...	30–35	...	...
blanca,	...	450	...	...	...	...	...	...	...	...	...	...
challengeri, n. sp.,	...	...	...	...	...	...	...	...	...	...	8	...
Sycon raphanus,	...	...	...	...	60–90	...	...	...	...	...	...	95–100
arcticum,	32	...	...	...	...	...	...	...	...	...	...	95–100
arboreum,	...	...	...	...	...	...	...	38–40	...	...	...	...
Grantia tuberosa, n. sp.,	...	...	?	...	...	...	...	...	...	...	...	...
Heteropegma nodus gordii, n. sp.,	32	...	...	...	...	...	...	...	...	...	8	...
Ute argentea, n. sp.,	...	...	...	...	...	...	...	...	120	...	...	...
Amphoriscus poculum, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
elongatus, n. sp.,	...	...	...	...	...	150	...	...	...	...	...	...
flamma, n. sp.,	...	...	...	s.w.	...	...	...	...	...	...	...	...
Anamixilla torresi, n. sp.,	...	...	...	...	...	...	...	...	...	...	3–11	...
Leucilla connexiva, n. sp.,	...	...	...	...	...	...	...	...	...	...	...	95–100
uter, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	95–100
Leuconia multiformis, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	95–100
typica, n. sp.,	32	...	...	...	...	...	...	...	..	...	...	...
rudifera, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	...
levis, n. sp.,	...	...	...	...	...	150	...	...	...	...	...	...
crucifera, n. sp.,	...	450	...	...	...	...	...	...	...	...	...	...
ovata, n. sp.,	...	...	...	...	...	...	70	...	...	...	...	...
loricata, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
fruticosa,	...	...	...	...	...	...	20–150	...	...	...	...	...
dura, n. sp.,	32	...	...	...	...	...	...	..	...	...	8	...
Pericharax carteri, n. sp.,	...	...	...	...	60	...	70	...	...	...	...	...
Leucetta imperfecta, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
vera, n. sp.,	...	...	...	...	...	...	10–100	...	...	...	...	...
hæckeliana, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
Eilhardia schulzei, n. sp.,	...	...	...	...	...	...	...	...	120	30–35	...	...

Note.—s.w. = shallow water.; the figures in the columns indicate the depth in fathoms; the species discovered by the Challenger are indicated by the letters n. sp.

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„	8.—*Leuconia multiformis*, n. sp., var. *goliath*; natural size.		

1 Leucosolenia Challengeri.
2 Leucosolenia blanca.
3 Ute argentea.
4 Sycon arboreum.
5 Amphoriscus flamma.
6 Grantia tuberosa.
7 Heteropegma nodus Gordii.
8 Leuconia multiformis var Goliath.

PLATE II.

PLATE II.

Figure 1.—*Leuconia multiformis*, var. *capillata;* natural size. Diam.

„ 2.—*Leuconia loricata*, n. sp., ... × 2

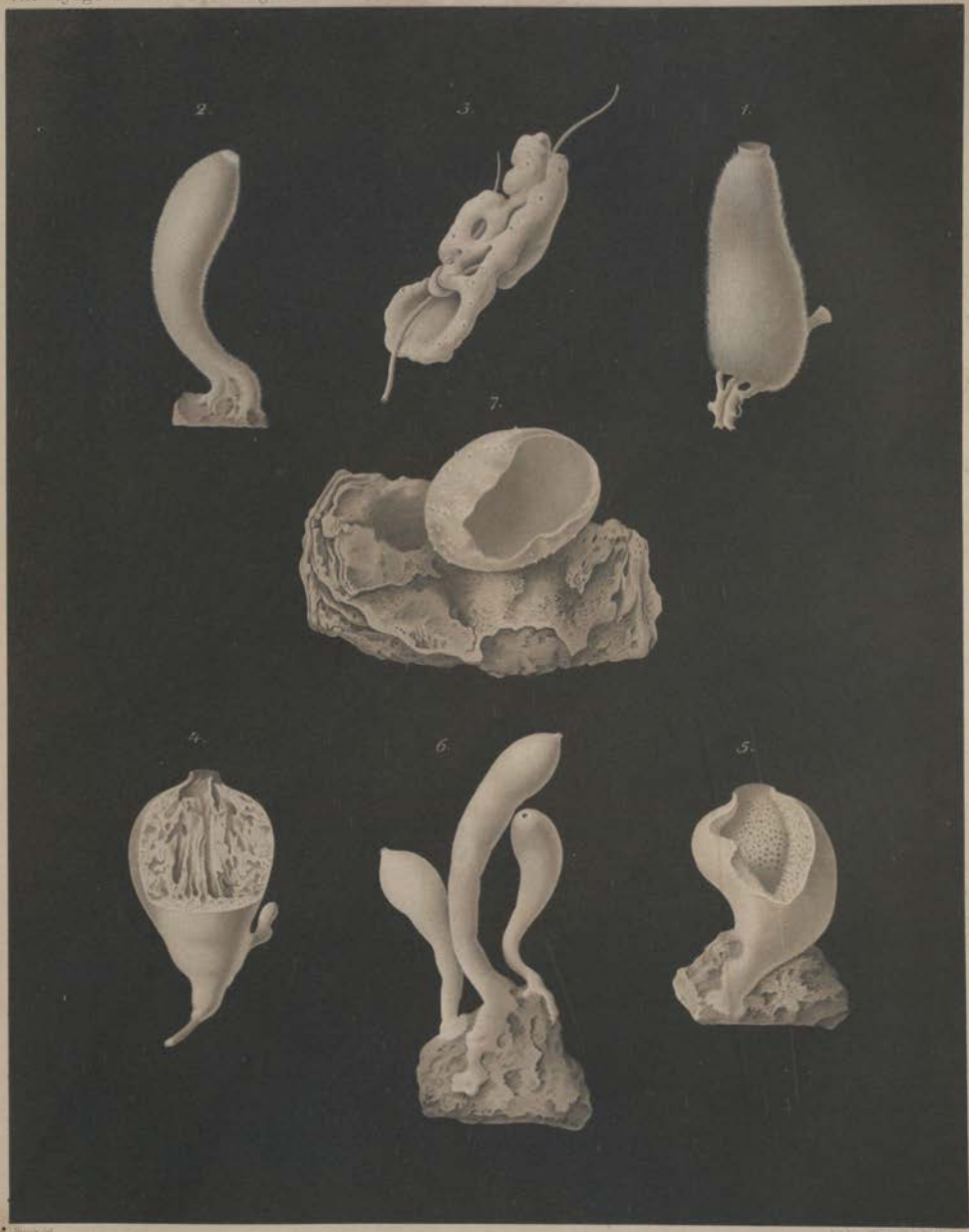
„ 3.—*Leuconia dura*, n. sp.; natural size.

„ 4.—*Leuconia fruticosa*, Hæckel, ... × 2

„ 5.—*Pericharax carteri*, n. gen. and sp.; natural size.

„ 6.—*Leucetta hæckeliana*, n. sp.; natural size.

„ 7.—*Eilhardia schulzei*, n. gen. and sp.; natural size.



1. Leuconia multiformis var capillata.
2. Leuconia loricata.
3. Leuconia dura.
4. Leuconia fruticosa.
5. Pericharax Carteri.
6. Leucetta Haeckeliana.
7. Eilhardia Schulzei.

PLATE III.

PLATE III.

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„ 4.—*Leucosolenia challengeri*, n. sp.

(*a*) A triradiate spicule from the interior part of the colony, . × 400
(*b*) A triradiate spicule from the outer surface, . . . × 400
(*c*) Do. profile view, . . . × 400
(*d*, *e*) Do. embryonal, ... × 400

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Fig. 8. Gastric quadriradiate spicules (*b*, embryonal), . × 200
Fig. 9. (*a*) A subgastric triradiate spicule, . . . × 200
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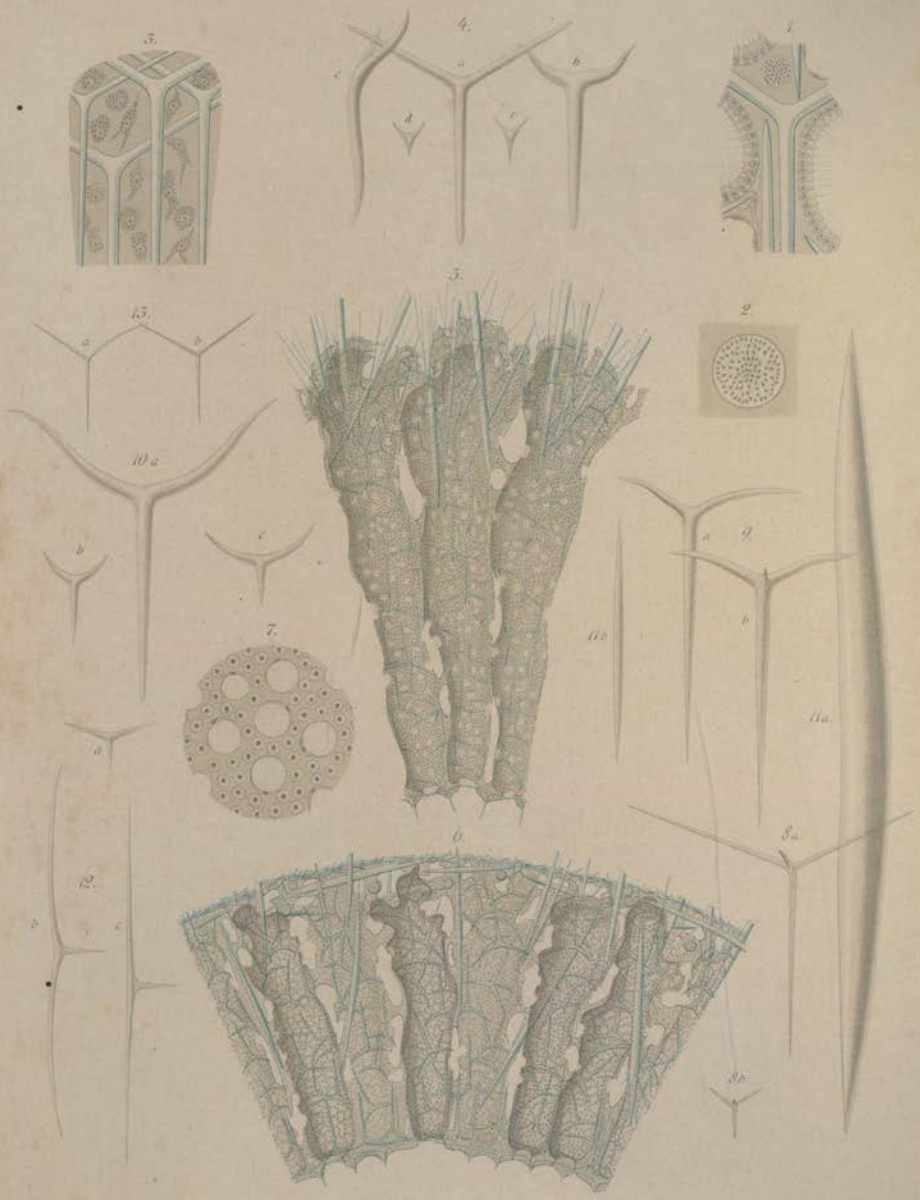
Fig. 13. Irregular triradiate spicules of the cortex, . . × 200



1-2. Leucosolenia poterium (?)
3. Leucosolenia blanca.
4. Leucosolenia Challengeri.
5. Sycon arcticum.
6-13. Grantia tuberosa.

PLATE IV.

PLATE IV.

Figure 1.—*Heteropegma nodus gordii*, n. gen. and sp. Diam.

(*a*) Portion of a horizontal section, ... × 50
(*b*, *c*) Two triradiate spicules of the cortex, . . . × 100
(*d*) Tubar and parenchymal quadriradiate spicules, . . × 200

,, 2.—*Anamixilla torresi*, n. gen. and sp.

(*a*) Portion of a horizontal section, ... × 50
(*b*) A gastric quadriradiate spicule, ... × 200
(*c*) A subgastric triradiate spicule, ... × 200

,, 3.—*Ute argentea*, n. sp.

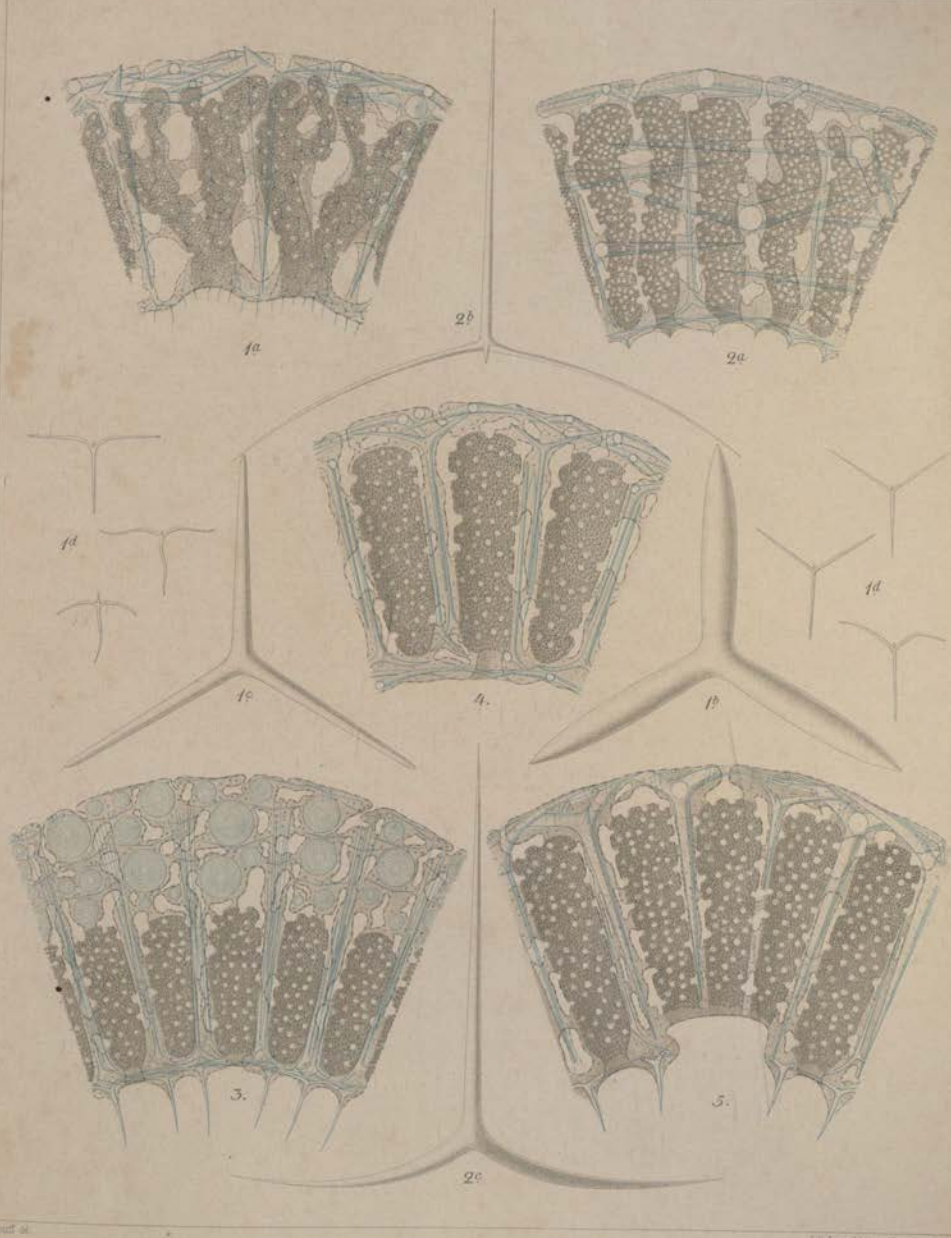
Portion of a horizontal section, ... × 100

,, 4.—*Amphoriscus poculum*, n. sp.

Portion of a horizontal section, ... × 100

,, 5.—*Amphoriscus elongatus*, n. sp.

Portion of a horizontal section, ... × 100



1 Heteropegma nodus Gordii.
2 Anamixilla Ferresi.
3 Ute argentea.
4 Amphoriscus poculum.
5 Amphoriscus elongatus.

PLATE V.

PLATE V.

Figure 1.—*Ute argentea*, n. sp. Diam.

(*a*) A subgastric triradiate spicule, ... × 200
(*b*, *c*) Two tubar acerate spicules, ... × 200
(*d*, *e*) Two gastric quadriradiate spicules, . . . × 200
(*f*) Do. embryonal, ... × 200
(*g*) A tubar quadriradiate spicule, ... × 400
(*h*, *l*) Two gastric acerate spicules, ... × 200
(*m*, *n*) Two dermal triradiate spicules, . . . × 200
(*o*) A young dermal acerate spicule, . . . × 200
(*p*) Do. fully developed transverse section, . . × 200

,, 2.—*Amphoriscus poculum*, n. sp.

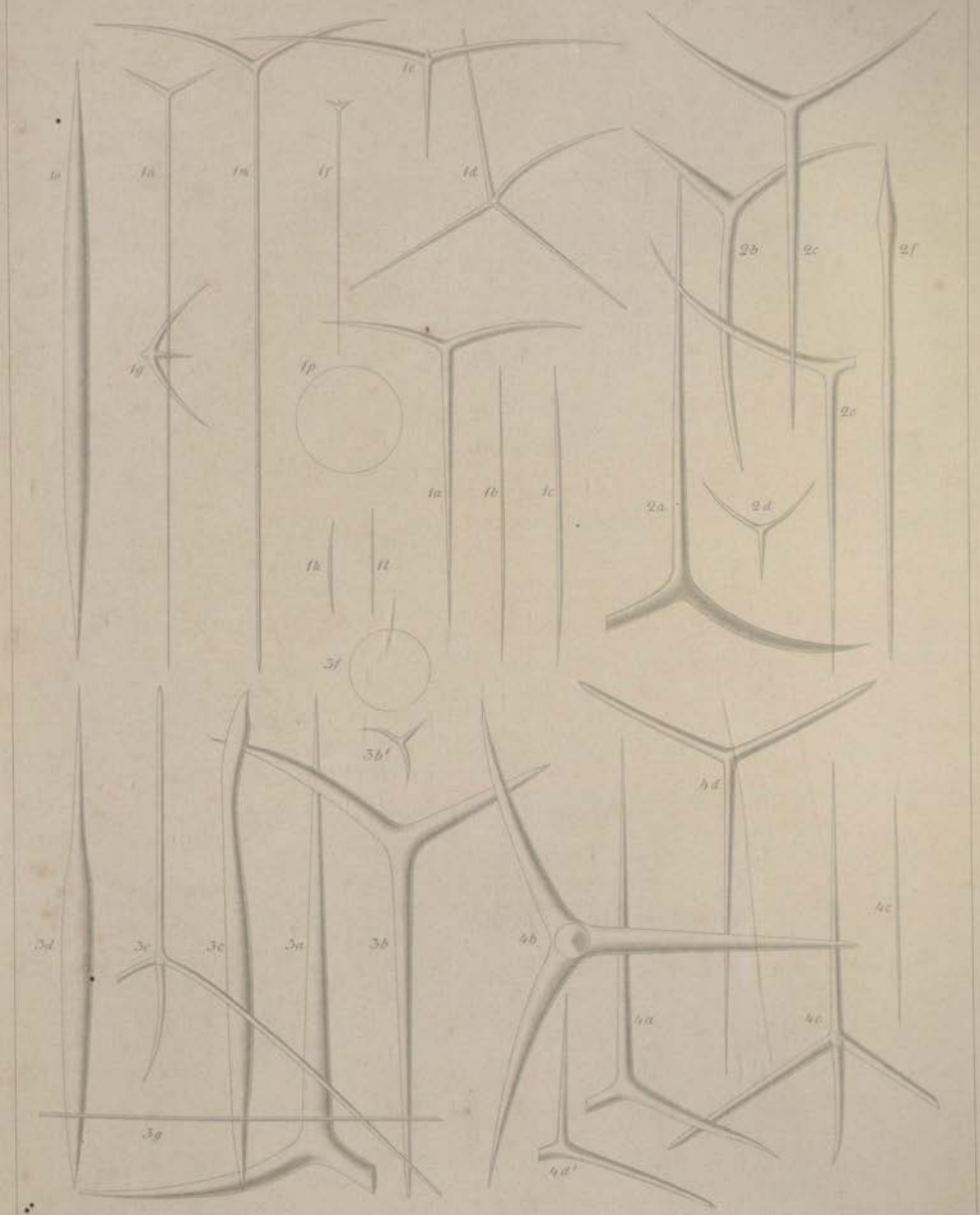
(*a*) A subgastric triradiate spicule, ... × 200
(*b*) A subdermal triradiate spicule, ... × 200
(*c*) A dermal triradiate spicule, ... × 200
(*d*) Do. embryonal, ... × 200
(*e*) A gastric triradiate spicule, . . . × 200
(*f*) A parenchymal acerate spicule, ... × 200

,, 3.—*Amphoriscus flamma*, n. sp.

(*a*) A subgastric triradiate spicule, ... × 200
(*b*) A subdermal triradiate spicule, ... × 200
(*b*[1]) Do. embryonal, ... × 200
(*c*) A gastric quadriradiate spicule, ... × 200
(*d*, *e*) Two young parenchymal acerate spicules, . . × 200
(*f*) The same, fully developed (transverse section), . . × 200
(*g*) A linear acerate spicule of the peristome, . . . × 200

,, 4.—*Amphoriscus elongatus*, n. sp.

(*a*) A subgastric triradiate spicule, ... × 200
(*b*) A subdermal quadriradiate spicule, . . . × 200
(*c*) A gastric quadriradiate spicule, ... × 200
(*d*) A dermal triradiate spicule, ... × 200
(*e*) A minute acerate spicule, ... × 200



1 Ute argentea.
2 Amphoriscus poculum.
3 Amphoriscus flamma.
4 Amphoriscus elongatus.

PLATE VI.

PLATE VI.

Figure 1.—*Leucilla connexiva*, n. sp.

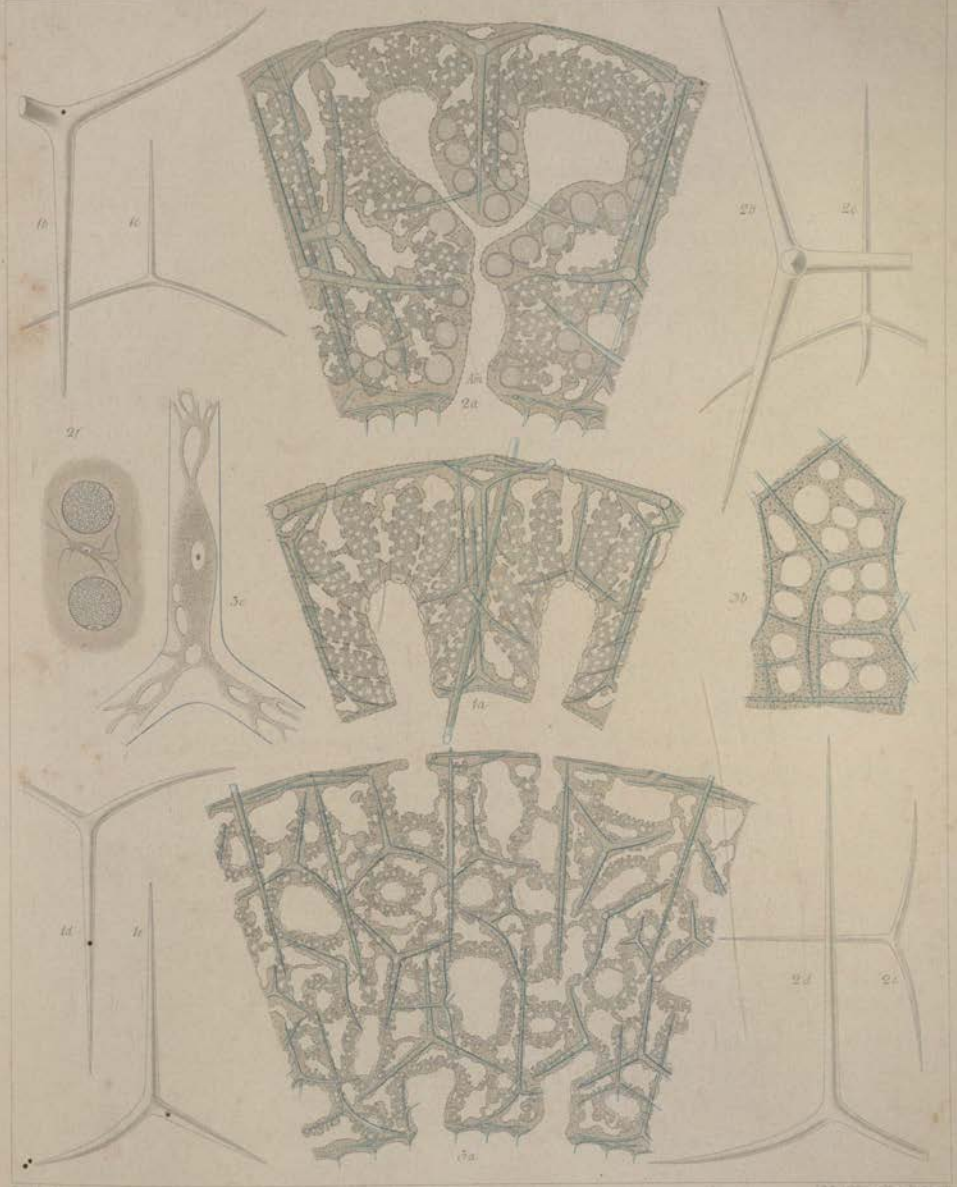
		Diam.
(*a*) Portion of a horizontal section,	×	50
(*b*) A dermal triradiate spicule,	×	100
(*c*) A gastric triradiate spicule,	×	100
(*d*) A subgastric triradiate spicule,	×	100
(*e*) A subdermal triradiate spicule,	×	100

,, 2.—*Leucilla uter*, n. sp.

(*a*) Portion of a horizontal section; *Am.* = Amphiblastulæ,	×	50
(*b*) A dermal quadriradiate spicule,	×	100
(*c*) A gastric quadriradiate spicule,	×	100
(*d*, *e*) Two subgastric triradiate spicules,	×	100
(*f*) Two spermospores,	×	1000

,, 3.—*Leuconia multiformis*, n. sp.

(*a*) Portion of a horizontal section,	×	30
(*b*) Piece of the dermal surface,	×	100
(*c*) A conjectural calcoblast,	×	800



1. Leucilla connexa. 2. Leucilla uter.
3. Leuconia multiformis.

PLATE VII.

PLATE VII.

Figure 1.—*Leuconia multiformis.*

			Diam.
(*a*) A gastric quadriradiate spicule,	×	100	
(*b*) A subgastric triradiate spicule,	×	100	
(*c*) A sagittal parenchymal triradiate spicule,	×	100	
(*d*) A young regular parenchymal triradiate spicule,	×	100	
(*e*) A dermal triradiate spicule,	×	100	
(*f*) Two minute acerate spicules,	×	100	
(*g*) A spindle-like large acerate spicule (transverse section),	×	100	
(*h*) A young lance-like acerate spicule,	×	100	

„ 2.—*Leuconia typica*, n. sp.

(*a*) A gastric quadriradiate spicule,	×	100
(*b*) A parenchymal triradiate spicule,	×	100
(*c*) A dermal triradiate spicule,	×	100

„ 3.—*Leuconia rudifera*, n. sp.

(*a*–*a*‴) Four minute gastric acerate spicules,	×	1000
(*b*) A gastric quadriradiate spicule,	×	100
(*c*) A dermal triradiate spicule,	×	100

„ 4.—*Leuconia levis*, n. sp.

(*a*) A gastric quadriradiate spicule,	×	100
(*b*) A subgastric quadriradiate spicule,	×	100
(*c*) A larger parenchymal triradiate spicule,	×	100
(*d*–*d*‴) Four smaller parenchymal triradiate spicules,	×	100

„ 5.—*Leuconia crucifera*, n. sp.

(*a*) A gastric quadriradiate spicule,	×	100
(*b*) A parenchymal triradiate spicule,	×	100
(*c*) A parenchymal quadriradiate spicule,	×	100
(*d*) A large acerate spicule (transverse section),	×	100

„ 6.—*Leuconia loricata*, n. sp.

(*a*–*a*⁗) Five minute acerate spicules,	×	2000
(*b*) A dermal triradiate spicule,	×	100

„ 7.—*Leuconia dura*, n. sp.

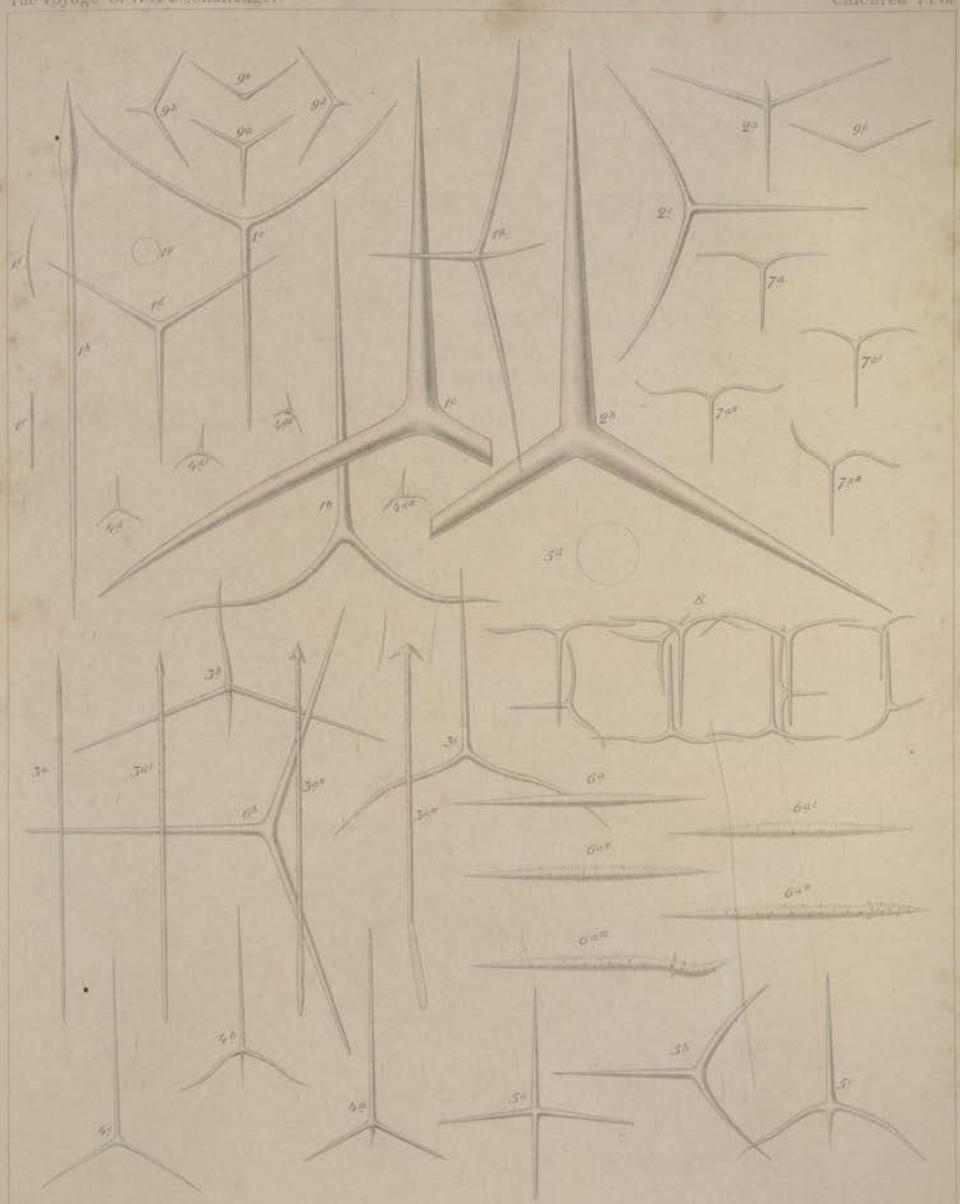
(*a*–*a*‴) Four oscular triradiate spicules,	×	100

„ 8.—*Pericharax carteri*, n. gen. and sp.

Ten subdermal spicules in their natural disposition (var. *heteroraphis*),	×	100

„ 9.—*Leucetta imperfecta*, n. sp.

(*a*–*e*) Five minute triradiate spicules,	×	500



1. Leuconia multiformis. 2. Leuconia typica. 3. Leuconia radifera. 4. Leuconia lens.
5. Leuconia crucifera. 6. Leuconia lorricata. 7. Leuconia dura. 8. Pericharax Carteri.
9. Leucetta imperfecta.

PLATE VIII.

PLATE VIII.

Figures 1–6.—*Leucetta hæckeliana*, n. sp. Diam.

Fig. 1. Portion of a horizontal section, . . . × 30
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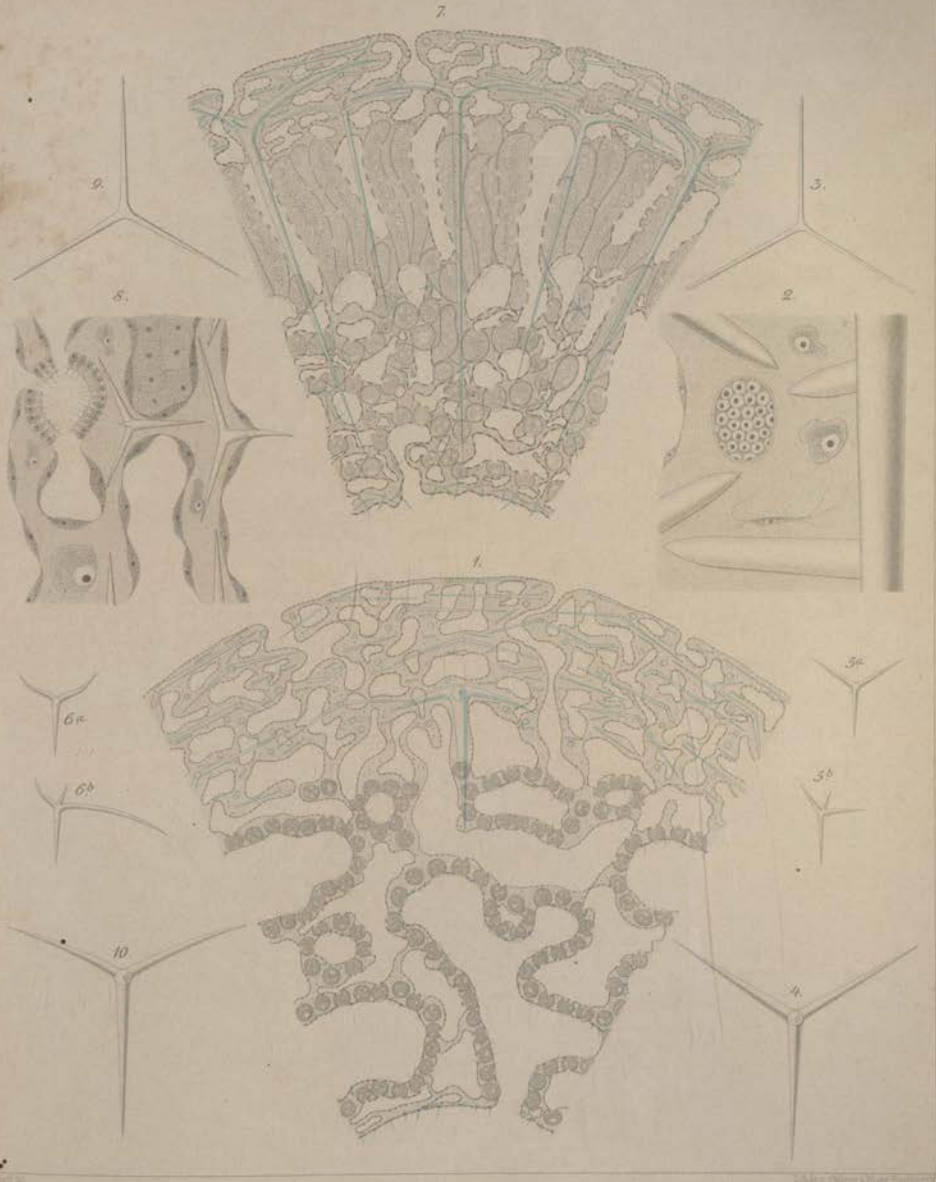
Fig. 4. A cortical quadriradiate spicule, (from the top), . . × 30
Fig. 5. A regular minute quadriradiate spicule (*a*, from the top, *b*, profile view), ... × 400
Fig. 6. A sagittal minute quadriradiate spicule (*a*, from the top, *b*, profile view), ... × 400

„ 7–10.—*Leucetta vera*, n. sp.

Fig. 7. Portion of a horizontal section, . . . × 30
Fig. 8. Portion of a section through the parenchyma near the inner surface, showing large, coarse-grained, pavement cells, . × 300
Fig. 9. A cortical triradiate spicule, . . . × 30
Fig. 10. A cortical quadriradiate spicule (from the top), . . × 30



1-6. Leucetta Haeckeliana. 7-10. Leucetta vera.

PLATE IX.

PLATE IX.

Figures 1–10.—*Eilhardia schulzei*, n. gen. and sp.

			Diam.
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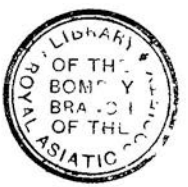
	(*b*, *c*) Two triradiate spicules of the convex surface,	×	50
	(*d*) An oscular quadriradiate spicule,	×	50
Fig. 6.	Three oscular triradiate spicules,	×	200
Fig. 7.	Two slender acerate spicules of the convex surface,	×	100
Fig. 8.	Five stout acerate spicules of the convex surface (*d*, *e*, embryonal),	×	100
Fig. 9.	Two acerate spicules of the osculum,	×	100
Fig. 10.	Minute acerate spicules of the sieve-like surface,	×	300

Eilhardia Schulzei.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THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the CIRRIPEDIA collected by H.M.S. Challenger during the years 1873-76. By Dr. P. P. C. HOEK, Member of the Royal Academy of Science of the Netherlands.

INTRODUCTION.

THE Cirripedia form together a group of Crustacea which, generally (Gerstäcker, Claus), is considered as an Order. The information we possess with regard to this Order is by no means insignificant: the splendid Monographs of which Charles Darwin has made it the subject[1] are alone sufficient to place it among the best known groups of invertebrate animals. The publication of these Monographs has been so eventful in the development of our knowledge of the group that I may be allowed to divide the history of that knowledge into two periods:—

I. Before the publication of Darwin's Monographs; and
II. From this publication up to the present date.

It would be quite superfluous to enter into details with regard to the history during the first period. As Darwin says in the preface of his Monograph on the Lepadidæ (p. 8), this history has been fully given by Burmeister[2] and by Martin St.-Ange,[3] and

[1] Darwin, C., A Monograph on the sub-class Cirripedia, with figures of all the species, Lepadidæ (1851), Balanidæ, Verrucidæ, &c. (1854), London, Ray Society. A Monograph on the fossil Lepadidæ, or pedunculated Cirripedes of Great Britain, London, 1851. A Monograph on the fossil Balanidæ and Verrucidæ of Great Britain, London, 1854.

[2] Burmeister, H., Beiträge zur Naturgeschichte der Rankenfüsser, Berlin, 1834.

[3] Martin Saint-Ange, G. J., Mémoire sur l'organisation des Cirripèdes et sur leurs rapports naturels avec les animaux articulés, *Mém. Savans étrangers*, vi. p. 513-555, Paris, 1835.

what was published between the dates of the works of these authors and that of Darwin's Monographs is to be found in the above preface. Moreover, this history has met with an exhaustive treatment at the hands of Prof. Gerstäcker, in Bronn's Klassen und Ordnungen des Thierreichs.[1] The parts in which the Cirripedia are treated were published in 1869, and so we find in the German work the history of our group continued till about 1867.

Of Darwin's Monographs two (1851 and 1854) give descriptions of the living species, two others (published in the same years) descriptions of the fossil ones. In the first, moreover, the anatomy, embryology, &c., of the different forms find ample treatment. The descriptions of the species are extremely exhaustive, each forming almost a monograph of its own; the discussion of the relations between the different species, and also of those existing between the genera, is doubtless among the best published in this department of Invertebrate Zoology. Finally, his studies, perhaps even more than those of Cuvier,[2] of Martin Saint-Ange, and Burmeister, are contributions to our knowledge of the anatomy of the group, and so have proved very valuable to Animal Morphology in general.

The way in which Darwin has compiled all the information scattered through zoological literature has been so thoroughly exhaustive and accurate, the way in which he made use of this information has been so very critical, that his works must necessarily form the basis of all future investigations. In comparison with the immense quantity of scientific information contained in his publications, but little has been added to our knowledge of the group since their appearance. I propose to bring these additions under three different heads:—

1. A sketch of the development of our knowledge with regard to the number of the genera and species known, their geographical and bathymetrical distribution.
2. A summary of what has been added to our knowledge of the anatomy, embryology, &c., of the group; and
3. A discussion of the different opinions published with regard to the classification of the group, especially since the discovery of the so-called Cirripedia Suctoria or Rhizocephala.

Under the first head I shall also refer briefly to the fossil genera and species described since the publication of Darwin's Monographs. It is much to be regretted that I have not been able to make the summary of the literature in this department more complete. As it was an utter impossibility to go personally over the whole of zoological literature

[1] Gerstäcker, A., Die Klassen und Ordnungen der Arthropoden wissenschaftlich dargestellt in Wort und Bild, Abtheilung 1, Crustacea, Hälfte 1, Leipzig und Heidelberg, 1865–79; Rankenfüssler, pp. 406–589, Taf. I.–VI.

[2] Cuvier, G., Mémoires pour servir à l'histoire naturelle et l'anatomie des Mollusques, Article Anatifa, 1817.

in search of descriptions of new fossil or recent species, my labours in this direction have been limited to examining carefully the contents of the different records of zoological literature.[1] Under the first head I shall treat only of the true nonparasitical Cirripedia.

Since the publication of Darwin's remarkable monograph, the Cirripedia of the English coast, and of the surrounding seas, have not much occupied zoologists. Only occasionally faunistic observations have been made and published, *e.g.*, by the Rev. A. M. Norman[2] (1868), in his report on the Shetland Crustacea. Three species of *Balanus* are mentioned in it, moreover, *Verruca strömia*, *Scalpellum vulgare*, and *Alcippe lampas*. The observations made by Lawson[3] (1858) and Adams[4] (1861) are rather biological than faunistic.

Leslie and Herdman[5] (1881) observed in the Firth of Forth one species of *Lepas*, two of *Conchoderma*, and four of *Balanus*. No new species were collected.

In more northern latitudes the Cirripedia are not represented by very many species. M. Sars[6] (1857) observed a new species of *Scalpellum* (*Scalpellum stroemii*) near Bergen, on the long spines of *Cidaris papillata*, living at a depth of 80 to 150 fathoms. Five other Cirripedia were collected by him in the North-Arctic region (four species of *Balanus* and one of *Verruca*). According to Heller[7] (1875), the only Cirriped taken during the Austro-Hungarian North-Polar Expedition is *Scalpellum stroemii*, Sars. Prof. G. O. Sars,[8] however, pointed out that the species of Heller is quite distinct from that of M. Sars: he therefore suggests a new name for it, and calls it *Scalpellum angustum*. During the great Norwegian North-Atlantic Expedition[9] three new species of *Scalpellum* (*Scalpellum striolatum*, *Scalpellum cornutum*, and *Scalpellum hamatum*; the first at a depth of 412 and 1081 fathoms; the second of 148, 350, and 416 fathoms; the third of 416, 457, and 620 fathoms) were added to those previously known, whereas at the same time the occurrence of *Scalpellum vulgare* at a latitude of 64° N. was ascertained.

In the Arctic region *Balanus porcatus*, Da Costa, occurs on the east coast of Greenland (Buchholtz),[10] near Cape Napoleon, Smith Sound, lat. 79° N. (Miers),[11] Barents-Sea and

[1] *Archiv. für Naturgeschichte*, 1855–1882; *Zoological Record*, vols. i.–xvii., 1864–1880; *Zoologischer Anzeiger*, vols. i.–vi. 1878–1883.

[2] Gwyn Jeffreys, Rev. A. Merle Norman, &c., Last Report on Dredging among the Shetland Isles, *Report Brit. Assoc.*, 1868, p. 301.

[3] Lawson, G., Remarks on Lepas anatifera, Lin., *Ann. Mag. Nat. Hist.*, ser. 3, vol. ii. 1858, p. 172.

[4] Adams, A., On the rapid growth of Cirripedes, *Zoologist*, 1861, p. 7321.

[5] Leslie, G. and W. A. Herdman, The Invertebrate Fauna of the Firth of Forth, *Trans. Roy. Phys. Soc.*, Edinburgh, 1881.

[6] Sars, M., Oversigt over de i den norsk-arctiske Region forekommende Krebsdyr. *Forhandl. Vidensk-Selsk Christiania*, 1859.

[7] Heller, C., Crustaceen, Pycnogoniden und Tunicaten der k. k. Oester.-Ungar. Nordp. Exped., *Denkschr. d. Math. Naturw. Cl. d. k. Akad. d. Wiss. Wien*, Bd. xxxv. 1875.

[8] Sars, G. O., Crustacea et Pycnogonida nova, *Archiv f. Math. og Naturv.*, Bd. iv. 1879, Kristiania.

[9] Sars, G. O., Prodromus descriptionis Crustaceorum et Pycnogonidarum, *Archiv f. Math. og Naturv.* Bd. ii. 1877, Kristiania.

[10] Buchholtz, R., Zweite deutsche Nordpolarfahrt, II. Zoologie, Cirrhipedia, p. 396, 1874.

[11] Miers, Edw. J., Crustacea in Sir G. Nares' Narrative of a Voyage to the Polar Sea, vol. ii. p. 240–248, 1878.

Matotsjkin-Shar (Nowaja-Zemlja) (Hoek),[1] &c. *Balanus balanoides*, Linn., was collected near Port Foulke, Arctic America (Miers),[2] and in the Matotsjkin-Shar (Hoek); *Balanus crenatus*, Brug., finally, occurs in Discovery Bay, Greenland, in 30 fathoms (Miers).

The species of Cirripedia occurring at the coast of Bohuslän are enumerated by A. W. Malm[3]: they are of the non-parasitic species, three species of *Balanus*, *Verruca strömia*, *Lepas anatifera*, *Lepas hillii*, and *Lepas fascicularis*, *Conchoderma virgatum*, and *Anelasma squalicola*.

The Cirripedia of the Baltic belong all to the genus *Balanus*. According to Prof. Möbius[4] they are *Balanus crenatus*, *Balanus porcatus*, and *Balanus improvisus*. The latter was observed in 1868, in the brackish water of the Ryk River, by Prof. Julius Münter,[5] and is found, moreover, at several points on the northern shores of Germany (Metzger).[6]

The Cirripedia of the German coast are not very numerous. Metzger[7] (1870) only mentions *Balanus porcatus*, *Balanus crenatus*, and *Balanus balanoides*, *Verruca strömia*, *Lepas anatifera*, and *Lepas anserifera*. *Chthamalus stellatus*, Poli, sp, is found near Heligoland, as was observed by me in 1877. Frey and Leuckart[8] (1847) described two new species of the same genus from the coast of Heligoland, but they are no doubt varieties of the species named above.

A list of the species found on the Dutch coast was published by me[9] in 1876. I observed only four species of *Balanus*, *Lepas anatifera*, and *Verruca strömia*. For the Belgian coast P. J. van Beneden[10] (1861) mentions only *Lepas anatifera* and a species of *Balanus*.

Of the Cirripedia of the French coast we possess lists published by Caillaud[11] (1865) and by Fischer[12] (1872). The latter enumerates eighteen different species:—four

[1] Hoek, P. P. C.. Crustaceen gesammelt während der Fahrten des Willem Barents, 1878 and 1879, *Niederl. Arch. f. Zool.* Suppl., Bd. i., 1882.

[2] Miers, Edw. J., On a small collection of Crustacea made in the North Greenland Seas, *Journ. Linn. Soc., Lond.*, Zoology, xv., 1880.

[3] Malm, A. W., Om Cirripeder funna vid Bohusläns Kust., pp. 26–32, *Göteborgs Naturh. Museum Zool. Zoot. Afd. III.* 1882.

[4] Möbius, K., Die wirbellosen Thiere der Ostsee. *Jahresber. d. Commiss. z. wissensch. Unters. d. deutschen. Meere* I. 1873.

[5] Münter, J., und Buchholtz, Ueber Balanus improvisus, *Mitth. naturwiss. Verein v. Neu-Vorpommern u. Rugen.* I., 1869, pp. 1–40.

[6] Metzger, A., Balanus improvisus, Darw., *Nachr. d. Deutschen mal. Gesellsch.* Bd. x. 1878, No. 1, pp. 7–9.

[7] Metzger, A., Die wirbellosen Meeresthiere der ostfriesischen Küste. Erster Beitrag. Hannover, 1870.

[8] Frey, H. und R. Leuckart, Beiträge zur Kenntniss wirbelloser Thiere, Braunschweig, 1847.

[9] Hoek. P. P. C., Eerste bydrage tot de kennis der Cirripedien der Nederlandsche Fauna, *Tijdschr. der Ned. Dierk. Ver.*, Bd. ii., 1876, pp. 1–46.

[10] Van Beneden, P. J., Recherches sur la faune littorale de Belgique, Crustacés, Bruxelles, 1861.

[11] Caillaud, F., Catalogue des Radiaires, des Annélides, des Cirripèdes et des Mollusques receuillis dans le département de la Loire-inférieure, Nantes, 1865.

[12] Fischer, Paul, Crustacés Podophthalmes et Cirrhipèdes du départment de la Gironde et des côtes du Sud-Ouest de la France, *Actes de la Soc. Linnéenne de Bordeaux*, xxviii., 1872.

of *Balanus* (*Balanus perforatus*, *Balanus improvisus*, *Balanus amphitrite*, and *Balanus balanoides*), one of *Acasta* (*Acasta spongites*), one of *Pyrgoma* (*Pyrgoma anglicum*), one of *Coronula* (*Coronula biscayensis*, van Beneden, which is probably the same as *Coronula balaenaris*, Gmelin), *Chthamalus stellatus*, *Verruca strömia*; five species of *Lepas*, *Conchoderma auritum* and *Conchoderma virgatum*, *Scalpellum vulgare*, and *Pollicipes cornucopia*. Cailliaud observed, moreover, *Alepas parasitica*, Rang, as an inhabitant of the French coast. With the exception of *Balanus amphitrite*, all these species are found also on the English coast.

The Mediterranean species are, I think, not sufficiently known. A new species of *Dichelaspis* (*Dichelaspis darwinii*) was described in 1861 by F. de Filippi.[1] I received, from the direction of the Zoological Station at Naples, specimens of that species, and also of *Lepas pectinata* and *anatifera*, *Scalpellum vulgare*, *Conchoderma virgatum* and *auritum*, *Alepas minuta*, and *Balanus perforatus*. These species occur in the Gulf of Naples or in its vicinity. It is likewise inhabited by *Balanus amphitrite*, as I know from having collected it myself. Heller[2] (1866) mentions a new species of *Conchoderma* (*Conchoderma gracile*), a delicate little species, occurring in the Adriatic Sea, and occupying the gills of *Maja squinado*. The great variability, however, of the members of this genus makes me hesitate before accepting this as a distinct species. He, moreover, observed in the Adriatic Sea *Lepas anatifera*, *Scalpellum vulgare*, *Chthamalus stellatus*, and *Chelonia testudinaria*. The latter on *Chelonia caretta*. Stossich[3] (1880) observed there the same species, and also *Balanus tintinnabulum*.

P. Mayer[4] (1878) published a short notice of the occurrence of *Conchoderma virgatum*, Spengler, on an undetermined species of *Pennella*, taken from *Xiphias gladius*, at Naples.

According to Marcusen[5] (1867), the Black Sea is inhabited by *Tetraclita porosa*, and some species of *Balanus*. Czerniavski[6] (1868) mentions for the Black Sea *Balanus improvisus*, Darwin, and an undetermined species similar to *Balanus declivis*, Darwin.

Noll[7] (1875) described a new genus of Cirripedia, which he called *Kochlorine*, and which was found by him near Cadiz, living in holes bored in the shells of *Haliotis*. According to him the new genus comes near to *Cryptophialus* and *Alcippe*, and so forms a third genus of the Abdominalia (Darwin). The species is called by him *Kochlorine*

[1] De Filippi, F., Sul genere Dichelaspis e su di una nuova specie di esso propria del Mediterraneo, *Arch. per. la Zool.*, I., 1861.

[2] Heller, Cam., Carcinologische Beiträge zur Fauna des adriatischen Meeres, *Verhandl. d. k.k. zool.-bot. Gesellsch. Wien*, Bd. xvi., 1866.

[3] Stossich, M., Prospetto della Fauna del mare Adriatico. III. *Bollet. Società Adriat. di Scienze naturali in Trieste*, VI., 1880.

[4] Mayer, P., Carcinologische Mittheilungen. V. Pennella und Conchoderma, *Mittheil. a. d. zool. Station zu Neapel.*, Bd. i., 1879.

[5] Marcusen, Zur Fauna des Schwarzen Meeres, *Archiv. f. Naturg.*, Jahrg. xxxiii., 1867.

[6] Czerniavski, Mat. Zoogr. Pont., p. 63, *Transact. first Meeting Russian Naturalists, St. Petersb.*, 1868 (Russian).

[7] Noll, F. C., Ueber Kochlorine hamata, *Zeitschr. f. wiss. Zool.*, Bd. xxv., 1875.

hamata. The same author of late (1883) has published a short note,[1] in which he mentions a species of the same genus *Kochlorine*, probably different from his *Kochlorine hamata*, and inhabiting cavities in a *Haliotis* shell from the Cape of Good Hope. For this second species the name of *Kochlorine bihamata* is proposed.

The Cirripedia of the North-American coast have been somewhat neglected by zoologists. In the report upon the invertebrate animals of Vineyard Sound and the adjacent waters, published (1873) by Prof. A. E. Verrill,[2] and in Dr. Spencer F. Baird's report for 1872, five species of *Balanus* (*Balanus amphitrite, Balanus eburneus, Balanus improvisus, Balanus crenatus*, and *Balanus balanoides*); *Coronula diadema*; four species of *Lepas* (*Lepas anatifera, Lepas anserifera, Lepas pectinata*, and *Lepas fascicularis*); and two species of *Conchoderma* (*Conchoderma auritum* and *Conchoderma virgatum*) are enumerated.

Macdonald[3] (1869) published a description of an "apparently new genus of minute parasitic Cirripeds, between *Lepas* and *Dichelaspis*." The species is called *Paradolepas neptuni*, and was found on the gills and respiratory appendages of *Neptunus pelagicus*, one of the swimming crabs occurring in great plenty at Moreton Bay (Australia). The species is, also, according to him, abundant at Sydney, and amongst the islands of the south-western Pacific. I believe the genus *Paradolepas* to be synonymous with *Dichelaspis*, Darwin. Macdonald met with another small pedunculate Cirriped in Nandi Bay, Vanua Levu, Fiji, also parasitic upon a swimming crab, but he neglected to decide whether this was identical with the other or not.

F. W. Hutton[4] (1878) has published a list of the New Zealand Cirripedia in the Otago Museum. The short notice contains an enumeration of eighteen species of Cirripedia, the description of two new species of *Elminius* (*Elminius sinuatus* and *Elminius rugosus*), and one new *Pollicipes* (*Pollicipes darwinii*), all three from New Zealand.

Fritz Müller[5] (1867) observed in Desterro, southern Brazil, a new species of *Balanus* (*Balanus armatus*). The species lives in sponges, and is distinguished by a rich and very peculiar armature of its cirri. The commonest species of *Balanus* occurring in the same locality is *Balanus improvisus*, var. *assimilis*, and the same author describes a probable hybrid between this variety and his *Balanus armatus*.

With regard to the Cirripedia inhabiting the skin of whales, we possess a paper from W. H. Dall,[6] and a short note, published by Steenstrup as a footnote to Lütken's Mono-

[1] Noll, F. C., Zur Verbreitung von Kochlorine, N., *Zoologischer Anzeiger*, No. 147, 1883, p. 471.

[2] Verrill, A. E., Report upon the Invertebrate Animals of Vineyard Sound, *U.S. Commission of Fish and Fisheries*, Part I., Washington, 1873.

[3] Macdonald, J. D., On an apparently new Genus of minute Parasitic Cirripeds, between Lepas and Dichelaspis, *Proc. Zool. Soc. Lond.*, 1869, p. 440.

[4] Hutton, F. W., List of the New Zealand Cirripedia in the Otago Museum, *Trans. N. Z. Instit.*, xi., 1878.

[5] Müller, F., Ueber Balanus armatus und einen Bastard dieser Art und des Balanus improvisus var. assimilis, Darw., *Archiv f. Naturgesch.*, Jahrg. xxxiii., 1867.

[6] Dall, W. H., *Proc. Californ. Acad.*, 1872.

graph of *Cyamus*.[1] The first (1872) mentions *Coronula diadema*, Lam., or perhaps a similar but distinct species from *Megaptera versabilis* of north-west America; *Cryptolepas rhachianectis*, a new genus and species of sessile Cirripedia found on *Rhachianectes glaucus*, Cope; in the third place *Otion stimpsoni*, Dall, sessile on *Coronula*, infesting *Megaptera versabilis*, but never on the surface of the whale itself. Steenstrup (1873) enumerates *Coronula balaenaris*, Gmelin, on right whales of the northern and southern hemispheres; *Coronula diadema*, Linn., on *Megaptera boops*, Atlantic and also southern hemisphere; *Coronula reginæ*, Darw., on unknown whales of the South Sea; *Tubicinella trachealis*, Sav., on northern and southern right whales; *Xenobalanus globicipitis*, Steenstrup, on *Globiocephalus melas* from the Faröe; finally, *Xenobalanus strictus*, Steenstrup, on several species of *Delphinus* from warmer parts of the Atlantic. Sars[2] (1880) observed *Conchoderma* (*vittatum*) *virgatum* on *Penella balaenopteræ*, which was taken from *Balaenoptera musculus*, and *Conchoderma auritum* and *Coronula diadema* on *Megaptera boops*.

During the cruise of the Austrian man-of-war "Novara," a small collection of Cirripedia was made. This was determined by Heller[3] (1865), and contained the following species:—*Lepas anatifera*, from the Cape of Good Hope; *Lepas anserifera*, from the Nicobars and Shanghai; *Lepas fascicularis*, from Rio Janeiro; *Conchoderma auritum*, from Auckland; *Pollicipes mitella*, from Hong Kong; *Balanus tintinnabulum*, from Madras and Chili; *Tetraclita porosa*, from Sydney; and *Chthamalus cirratus*, from the Nicobars.

A new species of *Dichelaspis* (*Dichelaspis aymonini*) was observed (1874) on the gills of *Macrochira kaempferi*, by Lessona and Tapparone-Canefri.[4] A new genus (*Ornitholepas*) was proposed (1874) by Targioni-Tozzetti[5] for a species of Cirripedia inhabiting the tail feathers of *Priofinus cinereus*, a bird of the Southern Atlantic and the Indian Ocean. Gerstäcker[6] supposes that the *Ornitholepas australis*, Targioni-Tozzetti, is only a larva of a Cirriped in its *Cypris*-stage.

Miers[7] (1881) observed one species of *Balanus* in a collection of Crustaceans from the Straits of Magellan, and two species of the same genus collected at Goru Island. The same author[8] (1880) took a great number of specimens of *Alepas tubulosa* from *Palinurus hügeli*, Heller, from Sydney Harbour.

[1] Lütken, Monograph of Cyamus, *Dan. Selsk. Skrift.* (5) x. p. 244, 1873.

[2] Sars, G. O., Fortsatte Bidrag til Kundskaben om vore Bardehvaler "Finhvalen" og "Knöllhvalen," *Forhandl. Vidensk. Selsk.*, Christiania, 1880.

[3] Heller, C., Reiseder Novara., Zool. Theil., Bd. ii., Abth. 3, Crustaceen, Vienna, 1865.

[4] Lessona and Tapparone-Canefri, *Atti Acad. Torino.*, ix., 1874.

[5] Targioni-Tozzetti, Di una specie nuova in un nuovo genere di Cirripedi Lepadidei, *Bull. Soc. Entom. Ital.*, iv., 1872.

[6] Gerstäcker, A., *Sitzber. Gesellsch. naturf. Freunde*, Berlin, 1875.

[7] Miers, Edw. J., Account of the Zool. Coll. made during the Survey of H.M.S. "Alert," Crustacea, *Proc. Zool. Soc. Lond.*, 1881.

[8] Miers, Edw. J., *Ann. and Mag. Nat. Hist.*, ser. 5, vol. v. 1880, p. 379.

Smith[1] (1880) observed *Tetraclita porosa* and *Lepas anatifera* in a collection of Crustaceans from Vancouver and Queen Charlotte Islands.

Ryder[2] (1879) observed a specimen of *Platylepas decorata*, Darwin, upon *Lepidosteus*.

These are all the new facts which I have been able to bring together relating to the number and geographical distribution of the living Cirripedia, and published since the appearance of Darwin's Monographs. In this department—as I have already said—the increase of our knowledge has not been considerable. The same may be said with respect to the fossil species. The results arrived at by Darwin are well known, and may be briefly summed up as follows :—

The genus *Pollicipes* embraces the oldest known Cirripeds,—*Pollicipes oolíticus* from the Lower Oolite, *Pollicipes concinnus* from the Middle Oolite, &c. In the Upper Chalk and the so-called Maestricht Formation the number of species known is the greatest.

The genus *Scalpellum* is the second ; it makes its appearance in the Lower Greensand, and is represented by about the same number of species as *Pollicipes* in the Upper Chalk.

The genus *Loricula* comes next ; the species described by Darwin is from the Lower Chalk. It is the only genus of fossil Cirripedia of which no recent representatives are known.

The genus *Verruca* is the first of the sessile[3] Cirripedia which makes its appearance. The oldest known species, *Verruca prisca*, is found fossil in Chalk, and in the Maestricht Formation. All the other sessile Cirripedia are represented in the Tertiary stages only.

The genus *Balanus* is represented by a single species in the Eocene ; the number of species increases towards the younger Tertiary deposits, but Darwin believes that if all the species of *Balani* hitherto found in the several Tertiary formations, from the Eocene to the Glacial deposits, throughout Europe, were collected together, they would not amount to twenty species. The number of recent species described by Darwin amounts to forty-five.

The genera *Acasta* and *Pyrgoma* are each represented by a single species in the Coralline Crag. Of both genera Darwin has mentioned nine living species.

The genus *Coronula* appears for the first time in the Red Crag. At present the genus numbers three species.

In 1857 a very interesting paper of Bosquet[4] was published on the fossil Cirripeds of the so-called Maestricht Formation. This paper contains the description of one new

[1] Smith, S. J., Notes on Crustacea collected by Dawson at Vancouver and the Queen Charlotte Islands, *Rep. Progr. Geol. Survey*, Canada, 1878–79.

[2] Ryder, John A., *American Naturalist*, July 1879.

[3] Darwin considers the Verrucidæ as a distinct family—according to him, therefore, *Balanus* is the oldest known genus of sessile Cirripedia.

[4] Bosquet, J., Notice sur quelques Cirripèdes récemment découverts dans le terrain Crétacé du Duché de Limbourg, *Natuurk. Verhandel. v. d. Holl. Maats. v. Wetensch.* Tweede Verzamel., xiii., 1857.

species of *Chthamalus*, one of *Verruca*, one of *Scalpellum*, and three of *Pollicipes* (*Mitella*, Oken, as Bosquet calls the genus), moreover, short notes about some species, descriptions of which were published by Darwin or by Bosquet in his Crustacés fossiles du terrain crétacé du Duché de Limbourg, 1853. The most interesting feature of the new publication of Bosquet is, in the first place, that *Chthamalus* is shown to occur in the Chalk of the Maestricht Formation,—the first instance of a true Balanid in secondary formations, if, with Darwin, we consider *Verruca* as a representative of a distinct family. In the second place, that a second species of *Verruca* was added to the only one known as occurring in secondary deposits.

In two different papers (1861 and 1864) Reuss[1] has largely increased our knowledge with regard to the fossil Lepadids. He has described two new species of *Scalpellum* from Tertiary deposits of the Oligocene formation of Söllingen near Crefeld, one new *Pollicipes* and one new *Pœcilasma* of the same Tertiary stage. The latter is represented by a single valve, which, being symmetrical, is considered as a carina; of course, the determination of Reuss may be correct, but as this would be the first instance of a *Lepadid* nearly related to *Lepas* being found in a Tertiary deposit, I think we had better not take it into consideration for the present. We ought to act in the same way with regard to the single valve which represents—according to Reuss—another species of *Pœcilasma* and was found in the Miocene Leitha-chalk of Podjarkow in Galicia. In these Miocene deposits Reuss observed, moreover, two species of *Pollicipes* and one of *Scalpellum*. Finally, the same author enumerates some forms from the Bohemian Cretaceous formation (two species of *Pollicipes* and one of *Scalpellum*), and three *Pollicipes* from the Mucronate Chalk of Nagorrani. One of the latter species is new.

Conrad[2] (1865) was only acquainted with two Cirripedia in the Eocene deposits of North America, viz., *Balanus humilis*, Conr., and *peregrinus*, Mort. Seeley[3] (1870) proposed a new species and a new genus for a scutum and a tergum of a sessile Cirriped found among some Lias fossils obtained at Lyme Regis. As far as the shape and the articulation are concerned, the valves resemble those of the Balanidæ, though the former do not display the muscular scars which distinguish the latter; in this respect they resemble the Verrucidæ. For these various reasons the author is inclined to regard the specimen as the type of a new family, intermediate between the Balanidæ and Verrucidæ. The species is called *Zoocapsa dolichoramphia*. I need hardly say that I do not wish to follow the author in his reasoning on this topic.

In 1878, Dames[4] made the very interesting discovery of a second species of *Loricula*

[1] Reuss, A., *Sitzungsb. d. math-naturw. Cl. d. k. Akad. d. Wiss. Wien*, Bd. xl., 1861; Ueber fossile Lepadiden, *Ibid.*, xlix., 1864.

[2] Conrad, Catalogue of the Eocene Annulata, Foraminifera, Echinodermata, and Cirripedia of the U. S., *Proc. Acad. Nat. Sci. Philad.*, 1865.

[3] Seeley, H. G., On Zoocapsa dolichoramphia, *Ann. and Mag. Nat. Hist.*, ser. 4, vol. v. 1870.

[4] Dames, Neue Art der Cirripedien-Gattung Loricula, *Sitzungsb. d. Gesellsch. naturf. Freunde*, Berlin, 1878.

in the Cretaceous deposits of the Lebanon. *Loricula syriaca* is represented by a single example affixed to a specimen of *Ammonites syriacus*. The species is smaller than the one described by Darwin, but is much more complete, and shows the correctness of Darwin's supposition with regard to the identification of the valves. In a footnote Dames makes mention of a third species of the same genus *Loricula*, which—according to Prof. Zittel—was found in the Cretaceous deposits of Dülmen in Westphalia.[1] So the genus *Loricula* seems to occur in all the strata of the upper Cretaceous formation. Marsson [2] (1881) enumerated the fossil Cirripedia found in the White Chalk of Rügen. There occur in it six species of *Scalpellum*, two of *Pollicipes*, and one *Verruca;* one *Scalpellum* (*Scalpellum depressum*) and one *Pollicipes* (*Pollicipes cancellatus*) are new to science.

Martin [3] (1880) described three species of *Balanus* (*Balanus tintinnabulum*, *Balanus amphitrite*, and *Balanus amaryllis*), as occurring in the Tertiary strata of Java. The same author [4] (1881) states that *Balanus amaryllis* occurs in the stream-tin-deposits of Blitong, and also [5] in newer Tertiary strata in the Padang Highlands of Sumatra. Berkeley Cotter [6] (1881) observed in the marine Tertiary deposits "do Tejo, do Sado e do Algarve," only *Balanus tintinnabulum* and a second species of *Balanus* which he has not determined.

During the so-called Mammoth Expedition, F. Schmidt [7] (1872) observed three species of *Balanus* (*Balanus porcatus*, *crenatus*, and *hameri*) sub-fossil at the mouth of the river Yenisei.

Together, all these scattered notes tend to show that *Pollicipes* and *Scalpellum* are the oldest genera of Cirripedia, fossils of which have as yet been found; that with a single exception (*Loricula*) the fossil Cirripedia belong to the same genera which still inhabit the seas; that the sessile Cirripedia only appear long after the pedunculate forms, and that *Verruca* is the oldest genus of sessile Cirripedia known. Comparing the large amount of information contained in Darwin's palæontological monographs with what has since been added to our knowledge, we need not wonder that the above-mentioned conclusions are nearly the same as those Darwin came to in 1854.

Recently Clarke [8] (1882) has published a note in which a "Cirriped Crustacean from the

[1] Under the name *Encrinurus egani*, n. sp., S. A. Miller has described (1879) a trilobite which, in general appearance at least, shows a very striking resemblance to *Loricula*. . . . (*Journ. Cincinnati Soc. Nat. Hist.*, vol. ii. 1879, p. 254, pl. xv. fig. 1). This fossil was found in the magnesian limestone of the Niagara group, at Joliet, Illinois.

[2] Marsson, Th., Die Cirripedien und Ostracoden der weissen Schreibkreide der Insel Rügen, *Mitth. naturwiss. Verein v. Neu-Vorpommern u. Rügen*, Bd. xii. 1881.

[3] Martin, K., Die Tertiärschichten auf Java, Leiden, Brill., 1879–80.

[4] Martin, K., On a post-tertiary fauna from the stream-tin-deposits of Blitong, *Notes Leiden Museum*, vol. iii. 1881.

[5] Martin und Wichman, Samml. des geologischen Reichsmuseums in Leiden (1), Bd. i. 1881–83.

[6] Cotter, J. C. Berkeley, Fosseis das bacias terciarias marinas do Tejo, do Sado e do Algarve, *Journ. Sci. Math. Phys. e Nat. Acad. Lisb.*, xxvi. 1881.

[7] Schmidt, F., *Mém. Acad. Sci. St. Pétersb.*, t. xviii. I. 1872.

[8] Clarke, J. M., Cirriped Crustacean from the Devonian, *Amer. Journ. Sci. and Arts*, ser. 3, vol. xxiv. 1882.

Devonian" is described. I learn from this note that Barrande has instituted a genus, *Plumulites*, for certain fossils regarded by him as the capitulum plates of sessile Cirripeds; this name *Plumulites* includes the genus *Turrilepis* proposed by Woodward for a form which he regarded as bearing a scaly peduncle; Barrande, "in regarding his specimens as all capitulum plates, and not the scales of the peduncle, has based his conclusions upon the external markings of the plates, rather than upon any such variation in shape and size as we should expect to find in the capitulum plates of a Lepadid." I have not been able to peruse the original work of Barrande; but judging from what Mr. Clarke states about the close resemblance of Barrande's specimens and his, and in the second place, from the figure Mr. Clarke gives of his specimens, the sessile nature of this Silurian and Devonian Cirriped appears to me to be very problematical. A good figure of the innermost side of the valve which is considered as the scutum of a sessile Cirriped would perhaps show the impossibility of supporting the view of Barrande and Clarke. The figure given resembles, by its triangular outline, the scutum of a Barnacle, but several species of *Scalpellum* and *Pollicipes* have scuta of a triangular outline as well. Finally, I need hardly recall the fact that they may be all capitulum plates, and yet belong to a pedunculate Cirriped.[1] However, the question whether these plates belong to a sessile or a pedunculate Cirriped must remain an open one; that they belong to Cirripedia can hardly be doubted, and this granted, we learn from it that our knowledge as to the distribution of the Cirripedia in time is very imperfect, and in the second place, that the conclusions arrived at, by comparing the living and the fossil forms, must be received with the greatest reserve.

With respect to the relation between the geological history of the Cirripedia and their occurrence at considerable depths, the information literature provides us with is extremely insignificant. Even the approximate ranges of depth at which the larger number of Cirripedia are found are not in our possession. Darwin (1854) says that *Balanus crenatus* inhabits water down to 50 fathoms, and (1851) that most of the species of *Scalpellum* are inhabitants of deep water. With the exception of the Norwegian Expedition of the "Vöringen," the earliest attempts to increase our knowledge with regard to the inhabitants of the great depths of the ocean were fruitless as regards the Cirripedia. As far as I am aware the species of *Scalpellum*, dredged by Prof. G. O. Sars, and published in his lists of new Crustaceans and Pycnogonids of the expedition of the "Vöringen," are the only instances, recorded in zoological literature, of animals of this order inhabiting the great depths of the ocean. In one of the letters, addressed to Prof. v. Siebold, during the voyage of H.M.S. Challenger, v. Willemoes Suhm stated that the only Cirriped often met with at a considerable depth, was the genus *Scalpellum;* but a careful examination of the collection put into my hands soon

[1] A third species of *Plumulites* (*Plumulites newberryi*) has been described by Mr. Whitfield from the Huron (Genesee and Portage) shales (*New York Academy of Science*, March 1882).

brought to light the fact that it is by no means the only genus of deep-sea Cirripedia.

What has been added to our knowledge of the anatomy and embryology of the Cirripedia since the publication of Darwin's book?

The beautiful researches of Krohn[1] are no doubt the best published on the anatomy of the Cirripedia since that date; they contain a detailed description of the cement-apparatus of *Lepas* and *Conchoderma*, and for the first time an accurate description of the female genital organs of *Lepas* and *Balanus tintinnabulum*. It is well known that Darwin[2] hesitated to accept the results which Krohn arrived at with regard to the opening of the oviduct into the sac at the base of the first pair of cirri. The exactness of Krohn's description was acknowledged by Kossmann,[3] after having been disputed by Pagenstecher.[4] I may add that the opening of the oviduct into Darwin's "auditory sac" requires very delicate dissecting, but that once achieved, a microscopic preparation may be made of the sac with the oviduct attached to it. In one of my preparations the oviduct, at a short distance from the sac, contains ovarian eggs. As was accurately stated by Darwin, the sac often contains a proportionally large and laterally flattened second sac, the opening of which is directed towards and attached to the opening of the oviduct in the outermost sac. Of course, since the supposition of Darwin as to the auditory function of the whole apparatus must be abandoned, his opinion as to the nature of this sac cannot be accurate. Krohn supposes that this innermost sac is furnished with a very elastic wall, which, when the sac is full of eggs, dilates very considerably, and loosens itself from the attachment of the oviduct, forming in this way the ovigerous lamellæ.

Kossmann, on the contrary, calls this shoe-shaped sack a "Klumpen," *i.e.*, an irregularly-shaped mass. According to him, this, if not totally solid, is only furnished with very irregular cavities, which cannot be filled with eggs from the oviduct. Even if one of these cavities were in direct communication with the oviduct, the contractions of the latter could never develop the force necessary to swell out the body till it formed the very tender cuticle which encloses the eggs of the Lepadids. The mass does not show a trace of a cellular structure, and though very extensile, it is very tough also, and offers great resistance to any tearing with needles. The mass is evidently the product of an aimless secretion of the epithelium-cells of the sac at the extremity of the oviduct. When the eggs pass through the oviduct these cells

[1] Krohn, A., Beobachtungen über den Cementapparat und die weiblichen Zeugungsapparate einiger Cirripedien *Archiv. f. Naturgesch.*, Jahrg. xxv. 1859.

[2] Darwin, Ch., On the so-called "Auditory-Sac" of Cirripedes, *Nat. Hist. Review*, 1863.

[3] Kossmann, R., Suctoria und Lepadidæ, *Arbeit. zool. zoot. Institt. Würzburg.*, i., 1874.

[4] Pagenstecher, A., Beitrag zur Anatomie und Entwickelungsgeschichte von Lepas pectinata, *Zeitschr. f. wiss. Zool.*, Bd. xiii. 1863.

secrete a thin viscous fluid which envelops the eggs. When no eggs pass through the oviduct the secretion continues incessantly, and in this way a thick mass is formed.

It is not my opinion that this little sac is a useless organ, and I believe that, after all, the interpretation of Krohn is more in accordance with the facts than that of Kossmann. The latter author, moreover, made an elaborate study of *Anelasma squalicola*,[1] with the intent to show that this Cirriped is not "in an embryonic condition," as Darwin supposed, but in a rudimentary state in consequence of its parasitic mode of life. The root-like ramifications of the peduncle—observed by Darwin—do not serve only to attach the animal to the skin of the shark (as was supposed by Darwin); with their aid the Cirriped sucks the greater part of its food out of the skin of the animal in which it is embedded. The simple, degenerated, condition of the parts of the mouth and of the cirri is a rudimentary state in consequence of disuse. No details are given as to the condition of the intestinal tract in the animal in question: whether it is in open communication with the connective tissue of the peduncle, &c. The root-like excrescences of the peduncle of *Anelasma* are compared by Kossmann with the roots of the parasitic Cirripedia, and according to this author *Anelasma squalicola* is an intermediate form uniting together *Lepas* and the parasitic Cirripedia.

Embryological papers have appeared in great variety since the publication of Darwin's book. It is not my intention to enter into details upon each of them; I only wish to trace the present condition of our knowledge concerning the Cirripedia. The curious metamorphosis of the Crustaceans of this Order discovered by Thompson,[2] is amply discussed in Darwin's Monograph. The researches made and published during the last thirty years bear almost entirely upon the segmentation of the egg and the formation of the blastoderm, which processes, since the publication of the papers of Filippi,[3] Münter and Buchholtz,[4] Hoek,[5] and Lang,[6] are tolerably well known. On the contrary, we are quite left in the dark as to the way in which the different organs are formed, what we are to understand by germinal layers in the case of the Cirripedia, &c.

Again, the result of the development within the egg is well-known. The Nauplius-larva, considered by the older observers[7] as a full-grown animal, has been recognised since the discovery of Thompson, as the larval form presented by the Cirripedia when first hatched. A second series of papers treats of the metamorphosis this larva undergoes before reaching the adult state, and compares the development of the Cirripedia with

[1] Kossmann, *loc. cit.*, p. 180.

[2] Thompson, J. V., Discovery of the metamorphosis in the second type of the Cirripedes, viz., the Lepades, completing the natural history of these singular animals, &c., *Phil. Trans.*, 1835.

[3] Filippi, F. de, Ueber die Entwicklung von Dichelaspis darwinii, *Moleschott, Untersuch.*, Bd. ix. 1865.

[4] Münter und Buchholz, Ueber Balanus improvisus, Darw., var. gryphicus, Münter, Abth. 2 *Mittheil. a. d. Naturwiss. Verein. v. Neu-Vorpommern u. Rügen*, i. 1869.

[5] Hoek, P. P. C., Embryologie von Balanus, *Niederländ. Archiv f. Zool.*, Bd. iii. 1876.

[6] Lang, A., Die Dotterfurchung von Balanus, *Jenaische Zeitschr.*, Bd. xii. 1878.

[7] O. F. Müller and others.

that of other Crustaceans which pass through this same larval stage. Since the development of the Copepoda is supposed to be a highly typical one, and since the comparison of these animals with the higher Crustaceans presents no great difficulties, the aim of the researches has been to homologise parts of the body—and especially the appendages—of the Cirripedia with those of the Copepoda. In this department the papers of Claus[1] take the first place. His last publication on the subject appeared in 1876, and in it he proposes the following homologisation of the appendages :—

The first pair of appendages of the Nauplius becomes in Cirripedia, as well as in Copepoda, the first antennæ. In the Cypris-stage of the Cirripedia these antennæ are well-developed, in the full-grown animal only rudimentary.

The second pair of appendages of the Nauplius, which in Copepoda develops into the double-branched second antenna, is cast off by the Cirripedia.

The third pair of appendages (*loc. cit.*, p. 76) in Copepoda changes into the mandibles, and in the development of the Cirripedia is cast off like the second pair (according to Metschnikoff,[2] and v. Willemoes Suhm).[3] According to Claus, it becomes the mandible. If the latter suggestion be right—but it is only supposed and has not been actually observed by Claus—the mandibles of both orders of Crustaceans are homologous.

Behind the third pair, a fourth pair of appendages has appeared. This pair, in the development of the Copepoda, becomes the maxillæ; in the advanced Nauplius-stage of the Cirripedia a double pair of knobs make their appearance in the same place; from the outside one, according to Claus, the maxillæ may develop, while the other one evidently produces the second maxilla (inner maxilla, Darwin). According to Metschnikoff, the mandibles and the maxillæ of the Cirripedia are together developed from this fourth pair of outgrowths.

As to the following pairs of appendages, the Copepoda will be spoken of first: a fifth pair of appendages has made its appearance behind the fourth; these are the maxillipeds, which, though double-branched, represent only one pair of limbs. Behind the maxillipeds are two new pairs of double-branched outgrowths; these eventually become the first two pairs of thoracic appendages (paddles, rowing-feet). The fourth and fifth pair of appendages belong to that part of the body, according to Claus,[4] which is covered by the cephalic shield; this seems to prove that he considers the sixth and seventh pair as not being placed under this shield, a suggestion which is, moreover, in accordance with his figure 4 on pl. xix. Neither is the carapace of the full-grown animal truly cephalic, since it also covers the first somite of the thorax; four distinct thoracic somites, each furnished with a pair of appendages, succeed the carapace, and behind this

[1] Claus, C., Die morphologischen Beziehungen der Copepoden, Phyllopoden, Cirripedien, &c., *Würzburger Naturwt. Zeitschr.*, iii. 1862; Die Cypris-ähnliche Larve der Cirripedien und ihre Verwandlung, *Schrift. der Ges. zur Beförd. d. gesammt. Naturw.*, 1869; Untersuchungen zur Erforschung der genealogischen Grundlage des Crustaceen-Systems, Wien, 1876.

[2] *Sitzungsb. der Versamml. deutsch. Naturf. zu Hannover*, 1865, p. 218.

[3] Willemoes Suhm, R. von, On the development of Lepas fascicularis, *Phil. Trans.*, clxvi., 1875.

[4] Untersuchungen, &c., p. 75.

thorax the full-grown Copepod has five abdominal segments, which are not furnished with appendages.[1]

The seven-appendage-stage in the development of the Copepoda Claus calls the Metanauplius-stage. According to him, the Malacostracous Crustaceans pass through the same stage. In the two groups (Copepoda and Malacostraca) the two pairs of antennæ and the mandibles are homologous; the maxillæ and the maxillipeds of the Copepoda are represented in the other group by two pairs of maxillæ; finally, the first two pairs of rowing-feet of the Copepoda correspond to the two pairs of maxillipeds of the Malacostraca.

Let us now return to the comparison of the Copepoda with the Cirripedia. Suppose the hypothesis of Claus is correct, then the mandibles develop from the third pair of larval appendages, and the fourth pair produces the maxillæ and also the second maxillæ; the fifth pair of appendages might then, as Pagenstecher[2] supposed, change into the first pair of cirri, in which case the other five pairs of cirri might be considered as homologous with the five thoracic feet of the Copepoda. To accept this supposition, it would, however, be necessary, Claus says, to prove that the fifth Nauplius-appendages could not possibly be lost by the Cirripedia.

If, on the contrary, the fourth pair of appendages develops into the maxillæ, and the fifth pair into the second maxillæ, or if, as seems to be the opinion of Claus, both pairs of maxillæ develop from the fourth pair of appendages, the fifth pair being lost, then the five thoracic feet of the Copepoda must be considered as homologous with the first five pairs of cirri of the Cirripedia. Finally, Claus is inclined to suppose that the knobs on the genital segment of the Copepoda, which may be shown to be a rudimentary sixth pair of rowing-feet,[3] correspond to the sixth pair of cirri of the Cirripedia. While the highly rudimentary genital knobs of the Copepoda, which ordinarily have totally disappeared, and which, when present, consist merely of a single articulation, are taken into consideration, the so-called caudal appendages of the Cirripedia, which in *Alepas, e.g.*, are eight-jointed, and which must be considered as a branch of a rudimentary seventh cirrus (Gerstaecker), are totally ignored. In conclusion, Claus says, that it does not matter much whether the one or the other hypothesis (viz., that of Pagenstecher or his own) proves to be true; they are of equal value for the main question, for in both the body of the Cirripedia is directly compared with the body of the Copepoda, and both hypotheses acknowledge the same appendages and the same segments for the body of Copepoda and Cirripedia. When both hypotheses can be true, of course they may both be false also. As long as neither of them is based on directly observed facts, the

[1] Claus. Lehrb. d. Zool., 4th Aufl., 1880, p. 544.

[2] Pagenstecher, Beitrag Zur Anat., &c., *Zeitschr. f. wiss. Zool.*, Bd. xiii., 1863.

[3] "Welcher nachweisbar ein rückgebildetes sechstes Ruderfusspaar ist" Claus says (Geneal. Grundl., p. 82). It is indeed curious that such a very interesting detail can be proved, yet never has been. In his classical monograph on the free-living Copepoda (Marburg, 1863), when describing the appendages of the body, the genital nobs are not mentioned at all, and in his Lehrbuch (4th Aufl., 1880) the same appendages are passed over in silence.

comparison of the two groups is a totally hypothetical one. At present this comparison is based upon the homology of the appendages, which homology is as yet quite uncertain.

Taking into consideration that the metamorphosis of the third and the fourth pairs of appendages of the Nauplius-larva into the mandibles and into the maxillæ has not been observed, and attaching more importance to the observations of Metschnikoff and v. Willemoes Suhm, who contend that the third pair of appendages has been lost, the latter saying, moreover, that the three pairs of gnathites are new formations;[1] considering, besides, that there is in most genera of Cirripedia a very distinct separation between the first and the second pair of cirri, the first standing very close to the mouth, and being of a very characteristic form, the latter being much more like the four remaining pairs,—I feel inclined to propose a comparison totally different from that of Claus. There are in a full-grown Cirriped three pairs of gnathites, and originally each of them represents a pair of appendages belonging to a distinct segment of the body. These appendages appear after the metamorphosis into the Cypris-larva has taken place, and then are placed between the three pairs of true Nauplius-appendages, and the so-called fourth pair of Claus.[2] This latter pair, is then really the seventh pair, and develops into the first pair of cirri. Not only in that case would this first pair of cirri correspond to the second pair of rowing-feet of the Copepoda, but we should also have in that part of the Cirriped-body, which in the adult is placed before the second pair of cirri, a part corresponding to the Metanauplius of the Copepoda. The five remaining pairs of cirri are —like the gnathites—not visible in the Nauplius-stage, when studied immediately before the metamorphosis into the Cypris-stage. They represent the appendages of the eighth to the twelfth segments of the body, and therefore may be considered as homologous with the thoracic feet of the Malacostraca. The abdomen of the full-grown Cirripedia is rudimentary; the only pair of appendages of this division is the pair of caudal appendages.

Though I believe that my hypothesis in many respects is more in accordance with the facts than that of Claus, yet in one point it is quite similar, viz., that it is based on the premise that the Nauplius-larva of a Cirriped and of a Copepod are homologous. This premise is so generally admitted that it seems almost ridiculous to doubt its truth. Yet we must not forget that the conformity of the two larval forms is by no means complete. The so-called "frontal threads" of the Cirriped-Nauplius are wanting in that of the Copepoda; the shell glands (antennal glands) of the second pair of appendages of the

[1] If the second pair of appendages has been lost, there is no reason why the third pair should not have shared the same fate. Of course in that case the mandibles of Copepoda and Cirripedia are not homologous parts; but I believe even Claus (*loc. cit.*, p. 81) does not attach, *a priori*, so much importance to this homology, as to accept it so long as it has not been proved by facts.

[2] The three pairs of gnathites are placed so close to one another as to appear to be attached to the same segment of the body. This, however, cannot be the original condition, and is to be considered as a falsification, in consequence of an abbreviation of the developmental process.

Copepoda (Grobben) are never observed in the Nauplius of the Cirripedia; the lateral horns and the very complicated system of dermal glands of the latter are again wanting in the Copepod-Nauplius. The various spinous processes of the Cirriped-Nauplius in the larva of the Copepoda are sought for in vain. No doubt a great many of these differences may be caused by adaptive changes, and be considered as secondarily acquired protective organs, as Balfour [1] calls them—yet this is also a supposition of a somewhat speculative character.

Moreover, we must not lose sight of the fact that it will always be very difficult to explain why the Cypris-stage, so highly characteristic of the ontogeny of the Cirripedia, is totally wanting in the development of the Copepoda, and why, when we consider an Archiphyllopod as the common ancestor of both groups, the Copepoda, which are developed from it in a much more direct way, should be unisexual, whereas the Cirripedia, as a rule, are hermaphrodite. Claus himself has pointed out this latter difficulty,[2] and tries to explain it by submitting that the hermaphroditism of the Cirripedia is of a secondary character. This supposition in the first place is based on the fact that the Cirripedia are not exclusively hermaphrodite, and in the second place, that in those cases in which unisexuality is observed in the group of the Cirripedia, it occurs in a stage which corresponds to the Cypris-stage of the ordinary development; a younger stage corresponding to an earlier period of the phylogenetic development. As this latter conjecture is based in the first place on the sexual relations of the different forms of *Scalpellum*, with which I shall have ample occasion to deal when describing the numerous species of that genus collected during the cruise of H.M.S. Challenger, a discussion of this point may be postponed till then.

An elaborate discussion of what had been published on the so-called Cirripedia Suctoria, or Rhizocephala, does not lie within the province of this Report. As not a single specimen of a *Sacculina* or a *Peltogaster* is to be found in the Challenger collection handed over to me, and as my inquiries of the gentlemen engaged in preparing reports on the Crustacea Podophthalmata, Brachyura, Anomura, &c.—the animals on which the parasitic Cirripedia are found living—have proved in vain, it seems that not a single representative of this group was taken during the cruise of H.M.S. Challenger.[3] Considering that Prof. Semper, during his stay in the Philippine Archipelago, collected nineteen different species of this group, it seems rather curious that not a single specimen was taken by the Challenger. The only way to explain it would be, that the Crustaceans living in shallow water in the neighbourhood of the coast are not very richly represented in the Challenger collection, and that the Cirripedia Suctoria at present known were taken, almost without an exception, from such shallow-water inhabitants.

[1] Balfour, Larval Forms, *Quart. Journ. Micr. Sci.*, vol. xx. p. 381, 1880.

[2] Claus, Genealogische Grundlage., p. 90, *et seq.*

[3] See note by the Editor of the Reports, p. 19.

However, it would be rather premature to draw the conclusion that the Crustacea Podophthalmata of the deep-sea do not suffer from parasitic Cirripedia.

Although Cavolini[1] (1787) published recognisable figures of the full-grown animals, and of the larva, and also showed the great resemblance of these larvæ to those of *Cyclops;* though different forms of these curious parasites were known long before 1854, from the papers of Rathke[2] and others;[3] though Thompson,[4] in 1836, speaks of a concealed affinity between these parasites and the Cirripedia, Darwin, as their true Cirripedial nature was not yet proved, could not take notice of them in his Monograph. Steenstrup[5] (1854) and Lindström[6] (1855) were, after Thompson, the first who suggested in their papers the relation of these parasites with the Cirripedia; but Lilljeborg[7] (1861) no doubt has the merit of having been the first to base this relation on anatomical grounds. Fritz Müller[8] (1863) (in the case of *Lernæodiscus* and *Peltogaster*) then showed that the second larval form of these parasites in almost every respect corresponds to the Cypris-larva of the Cirripedia, and though the same stage for *Sacculina* has not yet been observed, since his discovery the affinity of these highly degenerated parasites with the true Cirripedia has no longer been doubted. Lilljeborg regards them as true Cirripedia, and proposes for them the name of Cirripedia Suctoria. Fritz Müller, on the contrary, wishes to consider them as a distinct order of Crustaceans, which he calls the Rhizocephala, and which form an equivalent group to the nearly related Cirripedia. Since then our knowledge of these aberrant forms has not much increased. A large number of species has been added to those known to Lilljeborg, and the number of genera has also been considerably augmented.[9] The most important contribution to our knowledge of the anatomy of these curious parasites is contained in the papers of Kossmann. I have already pointed out (page 13) that this author considers *Anelasma squalicola* to be a link uniting the Cirripedia Suctoria with the true Cirripedia Thoracica—a view which I think requires confirmation by exact observation.

In 1865, Prof. H. de Lacaze-Duthiers published a provisional description of a parasitic animal of the Crustacean class, which he called *Laura gerardiæ*, and which was considered by him to belong to the Cirripedia.[10] On this same animal an elaborate memoir was published by the same author in 1882.[11] This very interesting parasite

[1] Cavolini, F., Memoria sulla generazione dei Pesci e dei Granchi, Napoli, 1787.

[2] Rathke, *Nova Acta Acad. Caes. Leop.-Carol. Nat. Cur.*, xx. p. 214, 1843?

[3] Diesing, Kröyer.

[4] Thompson, J. V., *The Entomological Magazine*, iii. 1836.

[5] Steenstrup, J. J., Bemaerkninger om Slaegterne Pachybdella, Dies. og Peltogaster, Rathke, *Oversigt o. d. K. D. Vid. Selsk. Forhandl.*, 1854.

[6] Lindström, G., Om larven til en art af Slägtet Peltogaster, *Öfversigt k. Vetensk.-Akad. Förhandl.*, 1855.

[7] Lilljeborg, W., Les genre Liriope et Peltogaster, Upsala, 1859–60.

[8] Müller, Fr., Die zweite Entwickelungstufe der Wurzelkrebse, *Archiv f. Naturgesch.*, Jahrg. xxix. 1863.

[9] So by the papers of Anderson (*Ann. and Mag. Nat. Hist.*, ser. 3, vol. ix., 1862), Semper (*Zeitschr. f. wiss. Zool.*, Bd. xiii., 1863), M. Sars (*Nyt Magaz. f. Naturvid.*, xvii., 1870), Kossmann (*Arbeit. zool. zoot. Instit. Würzburg*, i., 1872–74), Richiardi (*Atti. d. Socist Tosc. d. Scienz. Natural.*, i., 1874), G. O. Sars (*Arch. f. Math. og Naturvid.*, iv., 1880), and others.

[10] *Comptes rendus*, t. lxi., 1865.

[11] Histoire de la Laura Gerardiæ, *Mém. Acad. Sci. Paris*, t. xlii., Paris, 1882.

diverges in many respects from the typical structure of Cirripeds; yet, though perhaps a certain resemblance with some of the parasitic Isopoda is not to be denied, it would be hazardous, contrary to the authority of de Lacaze-Duthiers, to doubt its Cirripedial nature. The points in which it differs from the true Cirripedia are the following:—

1. The shell (carapace, test) has a very remarkable form, which perhaps slightly resembles that of the true parasitic Cirripedia (*Sacculina*, &c.). It almost entirely envelops the body, leaving only a very small aperture, and consists of a cartilaginous outer and a soft inner layer. Between the two layers the female genital organs and the liver are situated.

2. The extremities are one-branched, and bear a very remarkable relation to the genital organs; the oviducts open at the base of the first pair; the testes are placed in the four following pairs of limbs, and open at the basal joint of each leg with a distinct aperture. The sixth pair is short, and has nothing to do with the genital organs.

3. The structure of the head, with its small antennæ, and the parts of the mouth united to compose the "calotte céphalique." The latter forms a suctorial apparatus, which, however, according to Lacaze-Duthiers, is rudimentary in the adult animal.

4. The absence of the organs of respiration, and the high development of the circulatory apparatus.

5. Also the way in which the adult animal takes its food; the shell is overgrown by a polype (*Gerardia*), and the *Laura* sucks its food by means of ramifications of the capillaries which are spread through the shell, and which penetrate with countless roots the tissue of the polype.

6. Finally, the structure of the abdomen, which is distinctly segmented, the hindermost segment terminating in two anal appendices (pièces anales).

Lacaze-Duthiers proposes for this curious parasitic Crustacean a distinct group in the sub-order of the abnormal Cirripedia, which he calls the Ascothoracida or Rhizothoracida. No doubt the mutual relations of these abnormal Cirripedia with each other, as well as with the Cirripedia Thoracica, are still very imperfectly known, and new investigations are necessary.

NOTE ON THE RHIZOCEPHALA.

The naturalists of the Expedition have recorded the occurrence of *Peltogaster* in their Station Books and Journals several times during the cruise, viz.:—Station 158, March 7, 1874; lat. 50° 1′ S., long. 123° 4′ E.; 1800 fathoms; south of Australia, one specimen in the pouch of *Hymenaster*. On this specimen R. v. Willemoes Suhm has the following note:—"In the cavity of a *Hymenaster* which came up to-day there was a parasitic Rhizocephalid, showing a large sucker and a flat body filled with eggs. I could not find any anus, and am not

quite sure to which genus this animal has to be referred; but I think that it is nearest to *Clistosaccus*, Lillj., the only Rhizocephalid in which there is no anus. According to Gerstaecker, Peltogastridæ have only been found on the abdomen of Decapoda, from which this specimen might probably have been detached and fallen into the open breeding-cavity of the *Hymenaster*."

Station 200, October 23, 1874; lat. 6° 48′ N., long. 122° 25′ E.; Basilan Straits, Philippines, 255 fathoms. Two specimens of *Peltogaster* on Caridid shrimps.

Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; off Meangis Islands, 500 fathoms. One specimen of *Peltogaster* on Ophiurid. On this specimen R. v. Willemoes Suhm remarks:—"Near the mouth of an Ophiurid I found a large tumour, and inside a *Bopyrus* or *Peltogaster* inflated with eggs."

J. M.

I.—GEOGRAPHICAL AND BATHYMETRICAL DISTRIBUTION.

The following list contains the species collected during the cruise of H.M.S. Challenger, and the ranges of depth at which they occurred :—

Name of Species.	Depth at which Dredged.
Lepas anatifera, Linn.	Floating.
hillii, Leach, sp.,	,,
anserifera, Linn.	,,
pectinata, Spengler,	,,
australis, Darwin,	,,
fascicularis, Ellis and Solander,	,,
Conchoderma virgatum, Spengler, sp.,	,,
virgatum, var. *chelonophilum*, Leach,	,,
Balanus tintinnabulum, Linn. sp., var. *spinosus* (Gmelin),	,,
Tetraclita rosea, Krauss, sp.,	,,
Coronula diadema, Linn. sp.,	,,
Chthamalus challengeri, n. sp.,	,,
Balanus lævis, Brug.,	5–15 fathoms.
Tetraclita cærulescens, Spengler, sp.,	10 ,,
Balanus tintinnabulum, Linn. sp.,	7–20 ,,
Chthamalus dentatus, Krauss,	7–20 ,,
Acasta fenestrata, Darwin,	18 ,,
Balanus trigonus, Darwin,	6–80 ,,
socialis, n. sp.,	28 ,,
amaryllis, Darwin,	8–80 ,,
rostratus, n. sp.,	8–80 ,,
Scalpellum trispinosum, n. sp.,	82–102 ,,
Balanus tenuis, n. sp.,	100 ,,
Scalpellum africanum, n. sp.,	100 ,,
rubrum, n. sp.,	100–115 ,,
Megalasma striatum, n. gen. and sp.,	100–115 ,,
Scalpellum balanoides, n. sp.,	129 ,,
indicum, n. sp.,	129 ,,
Balanus corolliformis, n. sp.,	150 ,,
Scalpellum pedunculatum, n. sp.,	150 ,,
recurvirostrum, n. sp.,	150 ,,
stroemii, Sars,	83-516 ,,
Pœcilasma carinatum, n. sp.,	390–420 ,,

Name of Species.	Depth at which Dredged.
Pœcilasma gracile, n. sp.,	410 fathoms.
Alepas pedunculata, n. sp.,	410 ,,
Verruca nitida, n. sp.,	500 ,,
Scalpellum album, n. sp.,	500 ,,
tritonis, n. sp.,	516 ,,
Balanus hirsutus, n. sp.,	516 ,,
Scalpellum nymphocola, n. sp.,	540 ,,
japonicum, n. sp.,	565 ,,
Verruca sulcata, n. sp.,	520–630 ,,
Scalpellum acutum, n. sp.,	520–630–1000 ,,
parallelogramma, n. sp.,	600 ,,
triangulare, n. sp.,	600 ,,
intermedium, n. sp.,	410–700 ,,
novæ-zelandiæ, n. sp.,	700 ,,
hirsutum, n. sp.,	825 ,,
eximium, n. sp.,	1000 ,,
carinatum, n. sp.,	1000 ,,
elongatum, n. sp.,	410–1000 ,,
Dichelaspis sessilis, n. sp.,	1000 ,,
Verruca gibbosa, n. sp.,	1050 ,,
Scalpellum distinctum, n. sp.,	1070 ,,
flavum, n. sp.,	1375 ,,
tenue, n. sp.,	1375 ,,
vitreum, n. sp.,	1375 ,,
dubium, n. sp.,	1400 ,,
australicum, n. sp.,	1400 ,,
truncatum, n. sp.,	1400 ,,
moluccanum, n. sp.,	1425 ,,
velutinum, n. sp.,	1425 ,,
Verruca incerta, n. sp.,	1425 ,,
Scalpellum minutum, n. sp.,	1450 ,,
insigne, n. sp.,	1525 ,,
Verruca obliqua, n. sp.,	1525 ,,
Scalpellum brevecarinatum, n. sp.,	1600 ,,
antarcticum, n. sp.,	1675 ,,
Verruca quadrangularis, n. sp.,	1900 ,,
Scalpellum marginatum, n. sp.,	2000 ,,
ovatum, n. sp.,	2000 ,,
Scalpellum gigas, n. sp.,	2050 ,,
abyssicola, n. sp.,	2050 ,,
compressum, n. sp.,	2150 ,,
darwinii, n. sp.,	2160 ,,
planum, n. sp.,	2600 ,,
regium (Wyv. Thoms.), n. sp.,	2750–2850 ,,
regium, var. *ovale*,	2850 ,,

This list may be condensed into the following table, showing approximately how many times Cirripedia were dredged at certain depths.

Twelve species were taken at the surface.[1]

From dredgings in depths of from	0 to	500 fathoms	21	times.	
„ „ „	500 to	1000 „	13	„	
„ „ „	1000 to	1500 „	8	„	
„ „ „	1500 to	2000 „	5	„	
„ „ „	2000 to	2500 „	3	„	
„ „ „	2500 to	3000 „	3	„	
„ „ „	3000 to	4575 „	0	„	

As the exploration of the coasts of islands and continents was of secondary importance during the cruise of H.M.S. Challenger, we need not wonder that the Cirripedia of these regions are badly represented in the collections made during the voyage. Only occasionally were specimens collected in the neighbourhood of the coasts. At the same time this explains how it is that only a small percentage of the specimens collected belong to species described before: out of seventy-eight forms represented in the collection, nineteen only have been previously described, and fifty-nine are named and described here for the first time.

In 1854, Darwin[2] said "the number of known existing Cirripeds is 147." Since that date this number has only slightly increased. I am only aware of eighteen new species, but, as I have already said above, I am far from certain that I have brought together all the information which might be had from zoological literature. There can be little doubt, however, that this number is inconsiderable in comparison with the number Darwin knew when composing his Monograph, and also in comparison with that added during the cruise of H.M.S. Challenger. Hence I thought it would be of little use to prepare a list of all the species known at present, as I did in my Report on the Pycnogonida, in imitation of what Mr. Davidson had done for the Brachiopoda. I merely insert in the following table a list of the genera at present known, giving in separate columns the number of species known to Mr. Darwin, described since the publication of his Monograph, and collected during the cruise of H.M.S. Challenger. One of the columns gives in fathoms the hitherto ascertained depth of each genus.

We learn from this list that out of thirty-four genera of Cirripedia at present known, twenty-eight have never been observed at a depth greater than 150 fathoms. Two have been found from the shore to 400 fathoms (*Alepas* and *Pœcilasma*); *Balanus* occurs from the shore down to 510 fathoms; *Dichelaspis* ranges down to 1000 fathoms, and finally, only

[1] Some of them in numerous places—as, for instance, *Lepas anatifera*—others only once; so *Balanus tintinnabulum*, var. *spinosus*, taken from the screw of H.M.S. Challenger at St. Vincent.

[2] *Loc. cit.*, p. 166.

two genera have been hitherto observed at depths greater than 1000 fathoms, viz., *Scalpellum* and *Verruca*. The list shows very clearly that there are no deep-sea genera, for even of the two genera ranging lowest in depth, species are known from shallow water.

Name of the Genus.	Number of Species according to Mr. Darwin.	Number of Species described 1853–1883.	Number of new Species collected during Cruise of H.M.S. Challenger.	Range in Depth.	Name of the Authors who named the new Species.
Lepas, Linnæus,	6	...	...	Surface.	...
Pœcilasma, Darwin,	5	...	2	Unknown–420 fms.	Hoek.
Dichelaspis, Darwin,	5	3	1	Unknown–1000 fms.	Filippi, Lessona et Tapparone-Canefri, Macdonald, Hoek.
Megalasma, Hoek,	...	...	1	100–115 fms.	Hoek.
Conchoderma, Olfers,	3	2	...	Surface.	Heller, Dall.
Alepas, S. Rang,	4	...	1	Unknown–410 fms.	Hoek.
Oxynaspis, Darwin,	1	...	...	Unknown.	...
Anelasma, Darwin,	1	...	...	Surface.	...
Alcippe, Hancock,	1	...	...	15–20 fms.	...
Ibla, Leach,	2	...	...	Littoral.	...
Scalpellum, Leach,	6	5	43	15–20–300–2850 fms.	M. Sars; G. O. Sars, Hoek.
Pollicipes, Leach,	6	1	...	Littoral.	Hutton.
Lithotrya, G. B. Sowerby,	6	...	...	Unknown.	...
Cryptophialus, Darwin,	1	...	...	Unknown.	...
Proteolepas, Darwin,	1	...	...	Unknown.	...
Kochlorine, Noll,	...	2	...	Littoral.	...
Balanus, Auctorum,	39	1	5	0–150–516 fms.	F. Müller, Hoek.
Acasta, Leach,	8	...	...	Littoral-18(unknown).	...
Tetraclita, Schumacher,	8	...	...	Littoral–10 fms.	...
Elminius, Leach,	4	2	...	Littoral.	Hutton.
Pyrgoma, Leach,	9	...	...	12–35 fms.	...
Creusia, Leach,	1	...	...	Unknown.	...
Chelonobia, Leach,	3	...	...	Surface.	...
Coronula, Lamarck,	3	...	...	Surface.	...
Platylepas, J. E. Gray,	2	...	...	Surface.	...
Cryptolepas, Dall,	...	1	...	Surface.	Dall.
Tubicinella, Lamarck,	1	...	...	Surface.	...
Xenobalanus, Steenstrup,	1	1	...	Surface.	Steenstrup.
Chthamalus, Ranzani,	8	...	1	Littoral.	...
Chamaesipho, Darwin,	2	...	...	Littoral.	...
Pachylasma, Darwin,	2	...	...	Deep-sea.	Darwin.
Octomeris, G. B. Sowerby,	2	...	...	Littoral.	...
Catophragmus, G. B. Sowerby,	2	...	...	Littoral.	...
Verruca, Schumacher,	4	...	6	7–50–300–1900 fms.	Hoek.

Though unquestionably by far the greater part of the known Cirripedia are shallow-water species, and though some of the species are capable of existing at a considerable variety of depth, as for instance *Scalpellum stroemii*, Sars, found at 83 and also at 516

fathoms, yet it must be granted that the number of true deep-sea species of Cirripedia is very considerable.

There are	17	species	living	at a	depth	of from	500–1000 fathoms.
„	12	„	„	„	„	1000–1500	„
„	7	„	„	„	„	1500–2000	„
„	4	„	„	„	„	2000–2500	„
„	3	„	„	„	„	2500–2850	„

Often two or even three species of Cirripedia were brought up with the same haul of the dredge, as for instance :—

At Station 146.—*Scalpellum tenue, Scalpellum brevecarinatum, Scalpellum flavum.*
„ „ 135.—*Scalpellum eximium, Scalpellum carinatum, Scalpellum elongatum.*
„ „ 184.—*Scalpellum dubium, Scalpellum australicum, Scalpellum truncatum.*
„ „ 150.—*Scalpellum recurvirostrum, Balanus corolliformis.*
„ „ 204.—*Megalasma striatum, Balanus tenuis, Scalpellum rubrum.*
„ „ 214.—*Scalpellum album, Verruca nitida.*

And this seems to prove that there are places where the circumstances are especially favourable to the life of Cirripedia.

The occurrence of *Scalpellum* and *Verruca* in the great depths of the ocean coincides in a striking manner with the palæontological history of these genera. However, I have not been able to identify a single one of the recent species with those described by Darwin, Bosquet, and Reuss, in their palæontological memoirs. The fossil species of *Verruca* resemble much more those of the same genus which at present inhabit shallow water than those occurring at a considerable depth : the latter form together a very characteristic division of the genus. With regard to the genus *Scalpellum*, the fossil forms and those found in the deep sea have no doubt some features in common, yet I failed to ascertain a single instance of specific identity. To a certain extent this fact is explained by the very limited geographical distribution of the different species. With a few exceptions, the species were met with only once. These exceptions are the following :—

Pœcilasma carinatum, n. sp., dredged off Culebra Island (West Indies) and off Ascension Island.

Scalpellum elongatum, n. sp., dredged off Tristan da Cunha and off East Cape (Auckland).

Scalpellum velutinum, n. sp., dredged in the Atlantic Ocean, off Cape St. Vincent, and in lat. 32° 24′ S. long. 13° 5′ W.

Scalpellum stroemii, Sars, dredged south of Halifax and ("Triton" Cruise) north of Scotland.

Scalpellum acutum, n. sp., dredged off Miguel Island (Azores), and off Kermadec Islands (Pacific).

Scalpellum intermedium, n. sp., dredged off Sydney and off East Cape (Auckland).

All the other deep sea species were found only once, or at two Stations close to one another (*Scalpellum regium* at Stations 61 and 63, *Scalpellum brevecarinatum* at Stations 146 and 147). *Scalpellum stroemii*, Sars, is the only known deep-sea species which may be called a common species over a wide area of the North Atlantic. The most interesting instance of a species having a wide range, however, is *Scalpellum acutum*, found near the Azores, and in the Pacific near the Kermadec Islands; at both Stations, however, only a few specimens were taken. *Scalpellum elongatum* seems also to inhabit the Atlantic as well as the Pacific—specimens were collected at a very different longitude but almost exactly at the same latitude south in both oceans; but the specimens of the two Stations are not altogether alike, which may be due not only to the different sizes (ages) of the specimens, but also to specific difference. Of course continued investigations may show that what at present seems to be an exception, in reality must be considered as the rule; but with the knowledge we possess at present, we must arrive at the conclusion that the deep-sea genera have a world-wide range, but that the deep-sea species ordinarily have only a very limited distribution.

There is another fact of a very puzzling nature which presents itself when comparing the fossil forms with those of the deep sea. The eldest known fossil genus is the genus *Pollicipes*, and this genus is not represented at all among the forms living at a considerable depth. Yet it is by no means an extinct genus, being represented by seven living species, some of which have a very wide range. But these seven species are littoral forms, at least it is not recorded that any one of them was found at a depth of even 10 fathoms. Many of the fossil species, of which Darwin alone enumerates 22, were found side by side with species of *Scalpellum*, which proves that the species of the two genera once existed under the same circumstances of temperature, depth, &c. As the circumstances under which the fossil species lived are not known to us, and especially as we do not know at what depth they existed, it is extremely difficult—not to say impossible—to account for the fact that the descendants of one genus live in shallow water and those of the other in deep water; much more difficult, because in each genus the fossil and the living species are specifically distinct. As the species of *Scalpellum* live at very different depths, from the shallow water on the English and French coasts, in the gulf of Naples, &c., down to almost the greatest depths where animal life has been observed, we need not necessarily conclude that the deep-sea forms are those which have representatives in fossil deposits; yet it is true that the majority of the fossil species of *Scalpellum* (all those found in Secondary deposits) have the carina simply bowed and

the umbo at the apex, and that this holds good also for most of the deep-sea species. Hence we may venture to assert that in the case of *Scalpellum* the deep-sea more than the shallow-water forms have preserved the character of the oldest fossil species. The latter (*Scalpellum vulgare, Scalpellum ornatum, Scalpellum rostratum, Scalpellum stroemii*, &c.) have a fossil representative in the *Scalpellum magnum* described by Darwin, and taken from Tertiary strata (lower part of the Coralline Crag, &c.). On the contrary, Darwin, whose thorough knowledge of the whole group and of the affinities of the species we do not undertake to dispute, places the two oldest species of *Pollicipes* (*Pollicipes oolithicus* from the Lower Oolite, and *Pollicipes concinnus* from the Middle Oolite) in the same section of the genus in which he places also five of the six recent species known to him. And these were collected in shallow water! So we see that in one genus the deep sea forms have preserved more archaic characters, in another the shallow water forms. For a more detailed comparison of the living species of *Scalpellum* with the fossil species I refer to the descriptive part of my Report. Before taking leave of the subject, I beg to state that I cannot deny the possibility of future investigations of the deep sea bringing to light species of *Pollicipes* also as inhabitants of those regions, though at present I cannot but attach considerable value to the negative evidence, since the objects are relatively large, and since I could not suggest a reason why they should not have been brought up, if present, as well as the species of *Scalpellum*.

For the most part the species of Cirripedia are found in the neighbourhood of the coast. This is the case not only with all the species known to Darwin—with the exception, of course, of those attached to floating objects—but it is also the case with a great many of the species collected during the cruise of the Challenger; even the greater half of the true deep-sea species living at a depth of 500 fathoms and more, seem to occur only in the neighbourhood of the coasts of islands or continents.

The following species were found at a considerable distance from the coast:—

In the Atlantic Ocean:—

Scalpellum nymphocola, n. sp.
tritonis, n. sp.
insigne, n. sp.
regium (Wyv. Thoms.), n. sp.
triangulare, n. sp.
parallelogramma, n. sp.
Verruca quadrangularis, n. sp.
gibbosa, n. sp.
incerta, n. sp.

In the South Indian Ocean :—

Scalpellum tenue, n. sp.
brevecarinatum, n. sp.
flavum, n. sp.
antarcticum, n. sp.
planum, n. sp.

In the Pacific :—

Scalpellum abyssicola, n. sp.
gigas, n. sp.
darwinii, n. sp.
minutum, n. sp.

With regard to the geographical distribution of the Cirripedia, the four provinces into which Darwin divided the globe must be increased, I think, by two or three others. A new province must be added for the Cirripedia of the southern part of the Indian Ocean, and another for the species of Japan and of the North Pacific. The number of species known as inhabitants of these provinces is not yet very large, but—with a few exceptions only—these species are characteristic of the different regions, at least as far as our knowledge goes. I feel inclined, moreover, to divide the great Atlantic province into a northern and southern half, and as I cannot very well understand the difference in meaning between a province and a sub-province, I propose to consider the sub-province formed by Darwin for the southern extremity of Africa as a province also. So we should have the following eight provinces :—

I.—First or North Atlantic Province: the North Atlantic Ocean, from the Arctic regions to about latitude 10° N. This province embraces the coasts of Europe and North Africa, and of the eastern United States, besides the Mediterranean and the West Indies.

Dichelaspis lowei, Darwin.	Madeira.
darwinii, De Filippi.	Mediterranean.
sessilis, n. sp.	Atlantic.
Pœcilasma aurantium, Darwin.	Madeira.
crassum, Gray, sp.	Madeira.
carinatum, n. sp.	West Indies and (III.).
Alepas minuta, Philippi.	Mediterranean.
parasita, Sander Rang.	Mediterranean, Atlantic.

Alepas cornuta, Darwin.	West Indies.
Oxynaspis celata, Darwin.	Madeira.
Alcippe lampas, Hancock.	Atlantic.
Scalpellum vulgare, Leach.	Mediterranean, Atlantic.
stroemii, Sars.	North Atlantic.
striolatum, G. O. Sars.	North Atlantic.
hamatum, G. O. Sars.	North Atlantic.
angustum, G. O. Sars.	North Atlantic.
cornutum, G. O. Sars.	North Atlantic.
nymphocola, n. sp.	North Atlantic.
tritonis, n. sp.	North Atlantic.
insigne, n. sp.	Atlantic.
acutum, n. sp.	Atlantic and (V.).
regium (Wyv. Thoms.), n. sp.	Atlantic.
regium, var. *ovale*, n. sp.	Atlantic.
velutinum, n. sp.	Atlantic and (III.).
Pollicipes cornucopia, Leach.	Mediterranean, Atlantic.
Lithotrya dorsalis, Sowerby.	West Indies.
Proteolepas bivincta.	West Indies.
Kochlorine hamata, Noll.	Atlantic.
Balanus tintinnabulum, Linn., sp.	Madeira, West Indies, Atlantic (II., III., V.–VIII.).
tulipiformis, Ellis.	Madeira, Mediterranean.
stultus, Darwin.	West Indies (?) (VI.).
calceolus, Ellis.	Mediterranean (II., VI.).
galeatus, Linn., sp.	Atlantic, West Indies.
spongicola, Brown.	Atlantic, Mediterranean, West Indies (II.).
perforatus, Bruguière.	Mediterranean, Atlantic, West Indies (II.).
amphitrite, Darwin.	Mediterranean, West Indies (II., IV.–VII.), Red Sea.
eburneus, Gould.	Atlantic, West Indies.
improvisus, Darwin.	Atlantic (III. VIII.).
porcatus, da Costa.	Atlantic (VII. ?)
crenatus, Bruguière.	Atlantic, Mediterranean, West Indies (II.).
balanoides, Linn., sp.	North Atlantic, Atlantic.

Balanus declivis, Darwin.	West Indies.
hameri, Ascanius, sp.	North Atlantic, Atlantic.
hirsutus n. sp.,	Faröe Channel.
Acasta spongites, Poli, sp.	Mediterranean, Atlantic (II.).
cyathus, Darwin.	Madeira, West Indies.
Tetraclita porosa, Gmelin, sp.	West Indies (III.).
radiata, de Blainville, sp.	West Indies (V.).
Pyrgoma anglicum, Sowerby.	Mediterranean, Atlantic.
stokesii, Gray, sp.	West Indies.
cancellatum, Leach.	West Indies?
Creusia spinulosa, Leach.	West Indies (VI., VII.), Red Sea.
Chthamalus stellatus, Poli, sp.	Atlantic, Mediterranean, Madeira, West Indies (III., VI.–VIII.).
dentatus, Krauss.	Cape Verde Is., West Indies (?) (II.).
Pachylasma giganteum, Philippi, sp.	Mediterranean.
Catophragmus imbricatus, Sowerby.	West Indies.
Verruca strömia, O. F. Müller, sp.	Atlantic, Red Sea.
spengleri, Darwin.	Madeira.
nexa, Darwin.	West Indies.
obliqua, n. sp.	North Atlantic.

II.—Second or African Province, south of latitude 10° N.

Scalpellum ornatum, Gray, sp.	Algoa Bay.
Kochlorine bihamata, Noll.	Cape of Good Hope.
Balanus tintinnabulum, Linn., sp.	Cape of Good Hope (I., III., V.–VIII.).
capensis, Ellis.	Cape of Good Hope, Algoa Bay.
spongicola, Brown.	Cape of Good Hope (I.).
amphitrite, Darwin.	Gambia River (I., IV.–VII.).
perforatus, Bruguière.	Western Africa southward to Loanda (I.).
crenatus, Bruguière.	Cape of Good Hope (I.).
Acasta spongites, Poli, sp.	Cape of Good Hope (I.).
Tetraclita serrata, Darwin.	Cape of Good Hope, Algoa Bay.
rosea, Krauss, sp.	South Africa (V.).
Chthamalus dentatus, Krauss.	South Africa (I., West Indies?).
Octomeris angulosa, Sowerby.	Cape of Good Hope, Algoa Bay.

III.—Third or South Atlantic Province, embracing the South Atlantic Ocean, from latitude 10° N. to the Antarctic regions; east coast of South America.

Scalpellum velutinum, n. sp.	South Atlantic and (I.).
eximium, n. sp.	South Atlantic.
carinatum, n. sp.	South Atlantic.
elongatum, n. sp.	South Atlantic and (V.).
parallelogramma, n. sp.	South Atlantic.
triangulare, n. sp.	South Atlantic.
africanum, n. sp.	Nightingale Island, Tristan da Cunha.
Pœcilasma carinatum, n. sp.	South Atlantic and (I.).
Balanus tintinnabulum, Linn., sp.	South Atlantic and (I., II., V.–VIII.).
improvisus, Darwin.	Rio Plata, Southern Patagonia (I., VIII.).
armatus, Fr. Müller.	Desterro.
lævis, Bruguière.	Falkland Islands, Straits of Magellan (VIII).
psittacus, Molina, sp.	Patagonia and (VIII.).
Tetraclita porosa, Gmelin.	Brazil and (I., West Indies).
Elminius kingii, Gray.	Falkland Islands and VIII.
Chthamalus stellatus, Poli, sp.	Brazil, Rio Plata (I., VI.–VIII.).
scabrosus, Darwin.	Falkland Islands (VIII.).
Verruca quadrangularis, n. sp.	South Atlantic.
gibbosa, n. sp.	South Atlantic.
lævigata, Sowerby.	Eastern Patagonia (VIII.).
incerta, n. sp.	South Atlantic.

IV.—Fourth or South Indian Province, embracing the southern region of the Indian Ocean.

Scalpellum brevecarinatum, n. sp.	Between the Crozets and Prince Edward Island.
flavum, n. sp.	Between the Crozets and Prince Edward Island.
tenue, n. sp.	Between the Crozets and Prince Edward Island.
antarcticum, n. sp.	Near South Polar circle.
recurvirostrum, n. sp.	Between Kerguelen and Heard Islands.
planum, n. sp.	South of Australia.

Balanus amphitrite, Darwin	Madagascar (I., V.–VII).
corolliformis, n. sp.	Between Kerguelen and Heard Islands.
Tetraclita serrata, Darwin.	Algoa Bay (II.).
rosea, Krauss, sp.	Algoa Bay (V.).

V.—Fifth or Australian Province, including New Zealand.

Pœcilasma gracile, n. sp.	Off Sydney.
Dichelaspis neptuni, Macdonald, sp.	Australia, Islands of the South-Western Pacific.
Alepas tubulosa, Quoy and Gaimard.	New Zealand.
pedunculata, n. sp.	Off Sydney.
Ibla quadrivalvis, Cuvier, sp.	South Australia.
Scalpellum peronii, Gray, sp.	Swan River, Bass Straits.
acutum, n. sp.	Off Kermadec Islands and (I.).
elongatum, n. sp.	Off Auckland and (III.).
pedunculatum, n. sp.	Off New Zealand.
intermedium, n. sp.	Off Sydney and off Auckland.
novæ-zelandiæ, n. sp.	Off Auckland.
Pollicipes spinosus, Quoy and Gaimard, sp.	New Zealand.
sertus, Darwin.	New Zealand.
darwinii, Hutton.	New Zealand.
Lithotrya cauta, Darwin.	New South Wales.
Balanus tintinnabulum, Linn., sp.	Sydney (I.–III., VI.–VIII.).
nigrescens, Lamarck.	Swan River, Twofold Bay.
decorus, Darwin.	New Zealand.
trigonus, Darwin.	Sydney, New Zealand (VI.–VIII.).
concavus, Bronn.	(VI., VIII.).
amphitrite, Darwin.	Australia, New Zealand (I., IV., VI., VII.).
amaryllis, Darwin.	Moreton Bay, north-east coast of Australia (VI.–VIII.).
allium, Darwin.	Raine Island, Barrier Reef.
vestitus, Darwin.	New Zealand, New South Wales.
imperator, Darwin.	New South Wales, Sydney, Moreton Bay, &c.
Acasta sulcata, Lamarck.	Sydney, New South Wales, South and West Australia.

Acasta glans, Lamarck.	New South Wales, Southern Australia.
Tetraclita porosa, Gmelin, sp.	East coast of Australia (I., III., VI.–VIII.).
rosea, Krauss, sp.	New South Wales, &c. (IV.).
purpurescens, Wood, sp.	Australia, Van Diemens Land, New Zealand (VII.).
vitiata, Darwin.	Raine Island, Barrier Reef (VI.).
radiata, de Blainville, sp.	New South Wales (I.).
Elminius plicatus, Gray.	New Zealand, New South Wales.
simplex, Darwin.	New South Wales, Van Diemens Land.
modestus, Darwin.	New South Wales, Van Diemens Land, New Zealand.
sinuatus, Hutton.	New Zealand.
rugosus, Hutton.	New Zealand.
Chthamalus antennatus, Darwin.	New South Wales, Van Diemens Land.
Chamæsipho columna, Spengler, sp.	New South Wales, Tasmania, New Zealand.
Pachylasma aurantiacum, Darwin.	New South Wales.
Catophragmus polymerus, Darwin.	New South Wales, Swan River.
Verruca sulcata, n. sp.	Off Kermadec Island.

VI.—Sixth Province: Indian Archipelago (including the Philippines, Malacca, Borneo, Sumatra, Java, and New Guinea), and eastern coast of India.

Pœcilasma fissum, Darwin.	Philippine Archipelago.
eburneum, Hinds, sp.	New Guinea.
Dichelaspis warwickii, Gray.	Off Borneo.
Megalasma striatum, n. sp.	Off Luzon.
Ibla cumingii, Darwin.	Philippine Archipelago.
Scalpellum villosum, Sowerby.	Eastern Seas.
album, n. sp.	South of Mindanao.
dubium, n. sp.	Between New Guinea and Australia.
trispinosum, n. sp.	Basilan Straits, Philippine Archipelago.
australicum, n. sp.	Between New Guinea and Australia.
rubrum, n. sp.	Off Luzon.
truncatum, n. sp.	Between New Guinea and Australia

Scalpellum distinctum, n. sp.	New Britannia Archipelago.
moluccanum, n. sp.	Banda Sea.
balanoides, n. sp.	Banda Sea.
indicum, n. sp.	Banda Sea.
ovatum, n. sp.	North of New Guinea.
marginatum, n. sp.	North of New Guinea.
hirsutum, n. sp.	Moluccan Sea.
compressum, n. sp.	Celebes Sea,
Pollicipes mitella, Linn., sp.	Philippine Archipelago (VII.).
Lithotrya nicobarica, Reinhardt.	Timor, Nicobar Islands.
truncata, Quoy and Gaimard, sp.	Philippine Archipelago (VII.).
Balanus tintinnabulum, Linn. sp.	East Indian Archipelago (I.–III., V., VII., VIII.).
ajax, Darwin.	Philippine Archipelago.
cymbiformis, Darwin.	Near Madras.
navicula, Darwin.	Madras.
stultus, Darwin.	Singapore and (I., West Indies ?).
trigonus, Darwin.	Java, East Indian Archipelago.
concavus, Bronn.	Philippine Archipelago (V., VIII.).
amphitrite, Darwin.	(I., II., IV., V., VII.–VIII.).
patellaris(Gmelin), Spengler.	Bengal, Philippine Archipelago.
amaryllis, Darwin.	East Indian and Philippine Archipelago (V.).
Balanus quadrivittatus, Darwin.	East Indian Archipelago.
socialis, n. sp.	Arafura Sea.
tenuis, n. sp.	Off Luzon.
Acasta lævigata, Gray.	Philippine Archipelago and Red Sea.
fenestrata, Darwin.	Philippine Archipelago.
purpurata, Darwin.	Sumatra, Philippine Archipelago.
sporillus, Darwin.	Sooloo Islands.
Tetraclita porosa, Gmelin, sp.	Philippine Archipelago (I., III., V., VII., VIII.).
costata, Darwin.	Philippine Archipelago.
vitiata, Darwin.	Philippine Archipelago (V.).
coerulescens, Spengler, sp.	Philippine Archipelago (VII).
Pyrgoma grande, Sowerby.	Singapore and East Indian Archipelago.
milleporæ, Darwin.	Philippine Archipelago.

Pyrgoma crenatum, Sowerby.	Philippine Archipelago, Singapore.
monticulariæ, J. S. Gray.	Singapore.
Creusia spinulosa, Leach.	Philippine Archipelago, Singapore (I., VII.).
Chthamalus stellatus, Poli, sp.	Philippine Archipelago (I.–III., VII., VIII.).
intertextus, Darwin.	Philippine Archipelago.
Octomeris brunnea, Darwin.	Philippine Archipelago.
Verruca nitida, n. sp.	South of Mindanao.

VII. Seventh or Pacific Province (including China and Japan).

Pœcilasma kaempferi, Darwin.	Japan.
Dichelaspis warwickii, Gray.	China Sea.
aymonini, Lessona, Tappar.-Canefri.	Japan.
Scalpellum vitreum, n. sp.	Off Yeddo.
japonicum, n. sp.	South of Niphon.
gigas, n. sp.	Pacific Ocean.
abyssicola, n. sp.	Pacific Ocean.
Pollicipes polymerus, Sowerby.	Pacific Ocean and (VIII.).
mitella, Linn., sp.	China Sea and (VI.).
Lithotrya truncata, Quoy and Gaimard, sp.	Friendly Archipelago and (VI.)
Balanus tintinnabulum, Linn., sp.	(I., II., IV.–VII.), China, Galapagos Islands.
trigonus, Darwin.	Japan (V., VI., VIII.).
rostratus, n. sp.	Kobie, Japan.
amphitrite, Darwin.	Pacific Ocean (I., II., IV.–VI.).
amaryllis, Darwin.	Japan (V., VI.).
porcatus, Da Costa.	China ? (I.).
cepa, Darwin.	Japan.
Tetraclita purpurescens, Wood, sp.	China ? (V.).
coerulescens, Spengler, sp.	Pacific (VI.).
porosa, Gmelin, sp.	China, Galapagos Archipelago (I., III., V., VI., VII.).
Creusia spinulosa, Leach.	China (I., VI.).
Chthamalus stellatus, Poli, sp.	Coast of China, Gulf of Corea (I., III., VI., VIII.).

Chthamalus challengeri n. sp.	Japan.
Chamæsipho scutelliformis, Darwin.	"Probably from the seas of China," Darwin.

VIII. Eighth Province: West Coast of North and South America from Behring's Straits to Tierra del Fuego.

Scalpellum darwinii, n. sp.	Between Juan Fernandez and Valparaiso.
minutum, n. sp.	South Pacific.
Pollicipes polymerus, Sowerby.	Upper California and (VII.).
elegans, Lesson.	Coast of Peru, of Mexico, &c.
Cryptophialus minutus, Darwin.	Chonos Archipelago, Southern Chile.
Balanus tintinnabulum, Linn., sp.	Peru, California (I., II., IV.–VII.).
psittacus, Molina, sp.	Peru, Chiloe, Chile, Patagonia.
vinaceus, Darwin.	West Coast of South America.
trigonus, Darwin.	Peru, California (V., VI.).
lævis, Bruguière.	Chile, Peru, California (III.).
concavus, Bronn.	Panama, Peru (V., VI.).
pœcilus, Darwin.	West Coast of South America.
improvisus, Darwin.	Guayaquil, West Columbia (II., III.)
nubilus, Darwin.	California.
glandula, Darwin.	California.
cariosus, Pallas, sp.	Columbia River, Behring's Straits, Kurile Islands.
flosculus, Darwin.	Peru and Chile, Tierra del Fuego.
Tetraclita porosa, Gmelin, sp.	West Columbia, Panama (I., III., V.–VII.).
Elminius kingii, Gray.	Tierra del Fuego (III.).
Chthamalus stellatus, Poli, sp.	Northern California (I., III., VI., VII.).
cirratus, Darwin.	Peru, Chile, Chiloe, Northern Chonos Islands.
scabrosus, Darwin.	Peru, Chile, Chiloe, Tierra del Fuego (IV.).
fissus, Darwin.	California.
hembeli, Conrad, sp.	California.
Verruca lævigata, Sowerby.	Chile, Peru, Tierra del Fuego (III.).

II.—DESCRIPTION OF GENERA AND SPECIES.

Lepas, Linn. (1767).

Darwin enumerates six species belonging to this genus, all of which, as a rule, are found attached to floating objects, dead or alive. No new species of this genus has been proposed since the publication of Darwin's Monograph, nor has our knowledge as to their range been considerably augmented or altered. Five of the known species are found nearly all over the world, the sixth, *Lepas australis*, Darw., inhabiting the whole circumference of the Southern Ocean.

No fossil remains of a species of this genus have hitherto been found; it seems to be absent even from the newer Tertiary and Quaternary deposits. Perhaps this is because the genus has originated since that time. However, it is also possible that the genus existed in previous epochs, but that its attachment to floating objects was not favourable to its being preserved in fossil deposits. The genera of Cirripedia, fossil remains of which have been found as yet, are attached to fixed objects, and often are inhabitants of deep water.

It is by no means always easy to distinguish the species of this genus. From a careful examination, however, I am convinced that the diagnoses as given by Darwin are always sufficient. From these diagnoses I have composed the following table, which, of course, does not include all the variations often very considerably changing the exterior of some of the species.

Lepas.

1. Carina terminating in a flat oblong disc, . . . *Lepas fascicularis*, Ellis and Solander.
2. Carina terminating in a fork.
   - i. Valves furrowed.
     - (*a*) Occludent margin of the scutum arched, protuberant, ... *Lepas anserifera*, Linn.
     - (*b*) Occludent margin close to the ridge from the umbo to the apex, . . . *Lepas pectinata*, Spengler.
   - ii. Valves not furrowed.
     - (*a*) Valves smooth or delicately striated; internal umbonal tooth on the right hand scutum, *Lepas anatifera*, Linn.
     - (*b*) Valves smooth; no internal umbonal teeth on the scuta, ... *Lepas hillii*, Leach, sp.
     - (*c*) Valves smooth, thin, brittle; internal umbonal teeth on both scuta, . . . *Lepas australis*, Darwin.

Lepas anatifera, Linn. (Pl. I. figs. 1, 2).

Lepas anatifera, Linnæus, Systema Naturæ, 1767.
„ „ Darwin, Monograph Lepadidæ, 1851, p. 73.

This species shows considerable variations in size and shape. The largest specimen brought home by the Challenger has a capitulum of 45 mm. in length, whereas the largest observed by Darwin measured 51 mm. (two inches). Among the smaller specimens, those with a barbed carina (Darwin's var. *b.* "*dentata*") are by no means rare; of these the capitulum measures at the utmost 17 mm. None of the specimens are furnished with the diagonal line on scutum and tergum of dark greenish-brown, square, slightly depressed marks, as figured by Darwin (*loc. cit.*, pl. i. fig. 1). Curiously enough, I found the same lines very distinctly developed on the scuta and terga of specimens of *Lepas anserifera*, Linn., from the Pacific Ocean.

This extremely common species was only met with by the Challenger in the Atlantic Ocean. It inhabits the surface, attached to floating timber, vessels, &c. Very large specimens were collected towards the end of 1872, almost before regular observations were commenced. During the cruise itself it was observed at the following localities:—

Near Station 30, April 2, 1873, south of Bermuda. Numerous small and even extremely small specimens attached to a log and to each other. No ova. Carina smooth or barbed as in var. *b.* "*dentata.*" Larvæ in the Cypris-stage are affixed to the larger specimens, and to the surface of the log.

Near Station 74, July 1, 1873, off Fayal, Azores. Small quantity attached to a box. Not quite full-grown. Without ova. Carina smooth. Numerous larvæ in the Cypris-stage among the larger specimens.

Station 75, July 2, 1873, off Fayal, Azores. Two small specimens with a barbed carina; depth 50 to 90 fathoms. Although the specimens came up with the dredge, there can be no doubt but that they were taken at the surface.

Near Station 137, October 24, 1873; lat. 35° 59′ S., long. 1° 26′ E. Attached to a floating spar. Numerous specimens of different sizes; the larger ones with ova.

Cape of Good Hope, November 1873. Numerous specimens of very different sizes (capitulum 5–45 mm.). The larger specimens with ova; taken from a log of wood.

Observations.—A small bottle, labelled Station 244, 2900 fathoms, contains a right-hand scutum with the umbonal tooth. The shell has suffered considerably from the influence of the sea water, yet belongs doubtlessly to the present species.

Lepas hillii, Leach, sp. (Pl. I. fig. 3).

Pentalasmis hillii, Leach, Tuckey's Congo Exped., 1818, p. 413.
Lepas hillii, Darwin, Monograph Lepadidæ, 1851, p. 77.

Two young specimens of this species were taken from the screw of the Challenger at St. Vincent, Cape de Verde Islands, in April 1876, when on her return homewards.

Though young specimens, they agree in all essential regards with the diagnosis and description of Darwin. Two nearly full-grown specimens were taken from the screw in September 1875, in the Pacific Ocean, about Station 269. The fork of the carina is deeply embedded; the uppermost part of the peduncle has lost its orange colour, which may be due to the alcohol. Nor did I observe the yellowish beads on the chitinous membrane at the base of the capitulum, as described by Darwin. As stated by this author the filamentary appendages offer a good character, so I give, on Pl. I., figures of the basal articulation of the first cirrus, not only of this but also of the other species of this genus.

Lepas anserifera, Linn. (Pl. I. fig. 4).

Lepas anserifera, Linnæus, Systema Naturæ, 1767.
„ „ Darwin, Monograph Lepadidæ, 1851, p. 81.

On different occasions specimens belonging to this species were collected during the cruise of H.M.S. Challenger. Sometimes only a few, and at the same time small, specimens were collected; but on two occasions numerous and large specimens were taken. The former, probably, are young, while the latter, on the contrary, are full-grown and mature, being moreover frequently furnished with ovigerous lamellæ. As, however, their capitulum is only 23 mm. at the utmost, they have not reached the size of the largest specimen observed by Darwin, which had a capitulum one inch and a half (about 38 mm). in length. In one other respect, some of the larger specimens (collected at Raine Island) do not quite agree with Darwin's diagnosis; their valves are not approximate, but distinct, dark reddish-coloured interspaces being left between the scutum and tergum, and still broader ones between the carina and scutum and tergum. These interspaces do not occur in the smaller specimens, nor in the larger ones collected on the north coast of New Guinea.

The small specimens with approximated valves (Station 192) have a smooth carina; of the larger specimens (collected near Raine Island), the younger ones are furnished with a barbed carina, the eldest and largest ones, on the contrary, with a smooth carina. The small specimens (Station 192) have their occludent margin more rounded and their capitulum less elongated than the larger ones. In all the specimens the ridge running from the umbo to the apex is very distinct. In all the peduncle is extremely short. Those of Station 192, with a capitulum of almost 10 mm., had a peduncle of 3 mm. at the utmost; the larger specimens of Raine Island (capitulum 20 to 23 mm.) have a peduncle of 7 to 9 mm. The peduncle of the former specimens is very deeply embedded in the surface of the branch to which they were found attached. This is also the case with the short peduncle of the full-grown specimens from the north of New Guinea. The specimens of Raine Island are those of which I have already said above (p. 38) that they were

furnished with a line of slight quadrilateral depressions of a dirty brownish colour running diagonally across the capitulum. The line, however, is not a straight one, as in the case of *Lepas anatifera*, but an inflected one, the hollow side being directed towards the aperture of the capitulum.

I give a figure of the filamentary appendages of one of the largest specimens of this species in Pl. I. fig. 4. In the smaller specimens—as Darwin has already observed—the upper pair is represented by small knobs; in the larger specimens I found the most anterior of the upper pair and the lowest posterior pair the largest.

This species was collected:—Atlantic Ocean—May 6, 1876, on Gulfweed. A very small specimen, with the angle formed by the two occludent margins of the tergum larger still than 90°. South of Bermuda, surface. One small specimen attached to Gulfweed. Pacific Ocean—South-east of Raine Island, August 29, 1872. Numerous young and full-grown specimens. Moluccan Sea, Station 192, September 26, 1874; lat. 5° 42′ S., long. 132° 25′ E. The depth from which the dredge was hauled at this Station was 129 fathoms, but though the branch with the specimens of *Lepas* formed part of its contents, it does not prove that they were actually taken at the bottom. Near Station 217, February 22, 1875, north coast of New Guinea. Numerous specimens floating at the surface. North of the Low Archipelago, between Stations 275 and 276, September 15, 1875. Two small specimens, attached to one another and to a small piece of floating wood. Near Station 276, September 16, 1875, Low Archipelago. Small specimens attached to a floating *Janthina*.

Lepas pectinata, Spengler.

Lepas pectinata, Spengler, Skrifter Naturhist. Selskabet, II., 1793, p. 103, Tab. x. fig. 2.
„ „ Darwin, Monograph Lepadidæ, 1851, p. 85.

The furrowed surface of the specimens collected by the Challenger is very conspicuous; in almost every specimen all the ridges, and more especially that running from the umbo to the apex of each scutum, are covered with prominent calcareous spines.

Numerous specimens of this species were taken swimming at the surface, north of Cape de Verde Islands, on April 28 and 29, 1876. Some of them were taken at night, others by day. They were attached to shells of *Spirula*, and are of a very small size; some of the *Spirula* shells only bear one specimen, which is placed terminally, others are furnished with as many as three or even more specimens, in which case some are affixed terminally, others laterally.

A small piece of a *Spirula* shell was taken at the surface between Sydney and Wellington, the terminal portion of which was occupied by a great number of Cirriped-larvæ in the Cypris-stage. Among them was a small specimen of *Lepas pectinata*; this, as far as my knowledge goes, is the first instance of the species having

been observed in Australia. The latter specimen was taken in June 1874. Whether the Cypris-larvæ belong also to this species I cannot say with certainty; probably, however, they do.

Lepas australis, Darwin.

Lepas australis, Darwin, Monograph Lepadidæ, 1851, p. 89.

An inconsiderable number of specimens of this species were found attached to a piece of *Laminaria* (*Durvillia*?) picked up by the log line in the South Indian Ocean. There are three or four full-grown and numerous young specimens attached to the full-grown ones, and to the surface of the *Laminaria*.

The only difference worth noticing between the specimens described by Darwin and those brought home by the Challenger, consists in the greater size of the latter. Darwin states that his largest specimen has a capitulum of one inch long (25·4 mm.), whereas one of those of the Challenger collection measures no less than 33·6 mm.

The species was taken between Stations 143 and 144, December 22, 1873, lat. 40° S., long. 27° E., on floating sea-weed.

According to Darwin this species is common on *Laminaria* throughout the whole Antarctic Ocean. To this ocean it is confined, as far as our knowledge goes.

Lepas fascicularis, Ellis and Solander (Pl. I. figs. 5–7).

Lepas fascicularis, Ellis and Solander, Zoophytes, 1786, Tab. xv. fig. 5.
" " Darwin, Monograph Lepadidæ, 1851, p. 92.

During the cruise of the Challenger from Japan to Sandwich, along the thirty-fifth degree of latitude, great numbers of floating Lepadids were met with. A considerable quantity of these were collected and preserved in spirits. Dr. R. v. Willemoes Suhm (*loc. cit.*, p. 132), recognised in this Barnacle the very variable *Lepas fascicularis*, Ellis and Sol., which was described by Darwin. In his paper, published in the Transactions of the Royal Society, which is chiefly devoted to the development of this species, he enters into the discussion of the question, whether this Pacific form be really identical with the Atlantic form, or must be separated from it as distinct.

According to him, the only differences are seen in the mandibles and the maxillæ. Whereas the ordinary number of the teeth in the mandible is five, in most specimens he dissected there were six. "Sometimes, however, there are five on one side and six on the other, showing that this difference has no constant value." This difference is quite an imaginary one; on Pl. I. fig. 5 I give a figure of the mandible of one of the Pacific specimens of *Lepas fascicularis*. Von Willemoes Suhm would call this a

mandible with six teeth, Darwin, however, one with five teeth and an inferior point, which in this species is rather broad and finely pectinated. To show the correctness of my interpretation one has only to compare the figure of the mandible of *Lepas anatifera* in Darwin's Monograph (Lepadidæ, pl. x. fig. 5) with his description: "mandibles with, as usual, five teeth," &c.; moreover, when giving this description, Darwin refers to the figure in pl. x. According to Darwin, the maxillæ have four regular steps; according to v. Willemoes Suhm, they have sometimes four, and more commonly only three steps, besides the two large unequal upper spines. This difference does really exist, at least if Darwin's description is correct. I always observed only three steps, both in the maxilla of the Challenger specimens, from which Pl. I. fig. 6 is drawn, and also in the maxillæ of one of the specimens collected by the Brothers Krause in the neighbourhood of the Tschuktschen-Peninsula.[1] Von Willemoes Suhm, however, did not always observe the same number, and this shows clearly, I believe, that the importance of this difference is not very great. In the descriptions of the different species of the genus *Lepas*, Darwin, moreover, has given numerous instances of variations in the number of teeth, both in the mandible and in the maxilla. There is another point, however, which at first made me think it necessary also to consider this Pacific form as a distinct variety of the Atlantic one. This is the smoothness, when seen with the naked eye, of the chitinous membrane which covers the valves and fills out the interspaces between them. According to Darwin, this membrane is thickly clothed, especially in the interspaces between the two valves, with minute spines, barely visible to the naked eye. As I said above, the Pacific specimens, when seen with the naked eye, do not show a trace of spines, and only a certain roughness may be distinguished, which is occasioned—as an investigation with the microscope brings to light—by extremely thin and flat threads, which often seem to adhere to the chitinous membrane at more than one point. Often also numerous microscopic Algæ are present at the surface, and contribute not inconsiderably to this roughness. The specimens from the northern coast of Siberia, collected by the Brothers Krause, show exactly the same condition of the surface as the Challenger specimens.[2] In all other regards the Pacific specimens agree entirely with Darwin's description, except in so far as the size is concerned. And this is perhaps the most considerable point of difference between the Pacific and the Atlantic form. The size of the capitulum of the largest specimen does not quite reach 25 mm., whereas the Atlantic specimens often have a length of 40 mm. The large Atlantic specimens, though brittle, have a shell considerably stronger and more calcareous than the smaller specimens.

In the Pacific Ocean about 100 specimens (and often a much more considerable

[1] These specimens belong to the Natural History Museum of Bremen. They were kindly sent me for examination by the Director of the Museum, Dr. Spengel.

[2] In the Atlantic specimens this roughness is not the rule; of late I have been enabled to study specimens from Vineyard-Sound (United States of America), and these show exactly the same condition of the surface as those of the Pacific.

number still) are massed together into large floating balls; smaller (younger) specimens are, as a rule, observed among the larger ones.

The shell of the *Lepas* is often inhabited by an Annelid, as well as by the *Lepas* itself.

The bottles with the *Lepas fascicularis* are labelled July 6, 1875, North Pacific, surface (between Stations 248 and 249).

Great collections of larvæ in the first and in the later Nauplius-stages were made about the same locality in the Pacific.

Pœcilasma, Darwin, 1851.

Darwin founded the genus *Pœcilasma* for those Lepadids with the carina extending only to the basal points of the terga, with nearly oval scuta, having the umbones at the rostral angle, with the lower end of the carina either truncated or produced into a deeply embedded disc.

Gerstaecker (in Bronn, *loc. cit.*, p. 535), moreover, has stated in his description of this genus, that the caudal appendages are uniarticulate and always furnished with bristles, that the mandibles have four teeth, and that the anterior ramus of the second cirrus is not thicker than the posterior ramus.

Darwin describes five species of this genus. As far as my knowledge goes, no new species has been discovered since the appearance of his monograph.

Among the Lepadids of the Challenger I found two different forms which I believe must be considered as species of this genus; only it will be necessary to extend somewhat the generic description as given by Darwin. This, I think, is more in accordance with the principles followed by the author of the monograph of the Cirripedia, than to resolve on the creation of a new genus for every small deviation from the description proposed. Darwin has shown, by placing *Lepas fascicularis*, Ellis, in the genus *Lepas*, as well as by publishing the above copied diagnosis of the genus *Pœcilasma*, that he admits a considerable amount of variation in the shape of the carina within the limits of a single genus. And it is just the shape of that same carina which alone renders it difficult to place the two Challenger forms in the genus *Pœcilasma*. But as these forms in all other regards agree entirely with the generic description, I think this difference of less importance. Both species have the carina neither truncated nor produced into a deeply embedded disc; its two sides are considerably enlarged downwards, making the carina itself much deeper than in any of the other species of the genus (Pl. I. fig. 8; Pl. II. fig. 2). I therefore propose to include within the diagnosis of the genus *Pœcilasma*, Darwin (Hoek), the following description of the carina: the lower end of the carina either truncated or produced into a deeply embedded disc, or keel-shaped and considerably enlarged.

Four out of the five species known to Darwin live attached to Crustacea in the European and eastern warmer temperate and tropical oceans. One of these, *Pœcilasma kaempferi*, was found attached to *Inachus kaempferi*, de Haan (Japan), a crab probably from deep water; another, *Pœcilasma aurantium*, lives attached to *Homola cuvierii*, from Madeira, probably also a deep-water crab (Darwin); the third, *Pœcilasma crassum*, to the same *Homola cuvierii*; the fourth, *Pœcilasma fissum*, was found parasitic on a spinose crab under a stone at low water; the fifth, *Pœcilasma eburneum*, was found attached to broken off spines of an *Echinus* from New Guinea.

Of the two Challenger species, one comes from the Atlantic Ocean, the other from the Pacific; both species were found in the neighbourhood of the coast, and living at a depth of about 400 fathoms, attached to horny Corallines.

Two fossil species of this genus have been described by Reuss.[1] Good figures of the fossil remains are added to his description. The valve which represents the one species is considered by the author to be the carina. But as it does not resemble the carina of any of the known species of *Pœcilasma*, I think there are no reasons for accepting his determination. The other species is represented by a valve which is no doubt a scutum of a Lepadid. But this single valve is by no means sufficient to determine the genus.

The determination of the seven at present known species of the genus will be found easy by means of the following table:—

Pœcilasma, Darwin.[2]

Terga present.
1. Basal angles of the terga cut off.
   - (i.) Carina very narrow.
     - (*a*) Carina with a truncated and crested base, — *Pœcilasma kaempferi*, Darwin.
     - (*b*) Carina with a truncated base, ... *Pœcilasma aurantium*, Darwin.
   - (ii.) Carina widens downwards considerably (enlarged).
     - (*a*) Carino-tergal margin of the scutum hollowed out downwards for the widened part of the carina, — *Pœcilasma carinatum*, n. sp.
     - (*b*) Carino-tergal margin rounded as usual, . . . *Pœcilasma gracile*, n. sp.
2. Basal angles of the terga pointed.
   - (*a*) Scutum not divided into two segments, . . . *Pœcilasma crassum*, Gray, sp.
   - (*b*) Scutum divided into two segments, . . . *Pœcilasma fissum*, Darwin,

Terga wanting, . . . *Pœcilasma eburneum*, Hinds, sp.

Pœcilasma carinatum, n. sp. (Pl. I. figs. 8–10; Pl. II. fig. 1; Pl. VII. figs. 6, 7).

Valves five; carina considerably enlarged downwards, terminating in an indistinct fork; umbonal teeth of the scutum not very strong; carino-tergal margin concave in the undermost half for the reception of the widened part of the carina; terga with the basal point

[1] Ueber fossile Lepadiden, *Sitzungsb. d. math.-naturw. Cl. d. k. Akad. d. Wiss. Wien*, Bd. xlix. 1864, pp. 215–246, with 3 plates

[2] Darwin regards *Pœcilasma* as feminine, though the Greek word ἔλασμα is neuter.

truncated, almost parallel to the occludent margin. Maxillæ with stronger spines above and slenderer spines beneath the notch, which itself is without spines. Caudal appendages with numerous long bristles on their summits.

General appearance—Capitulum rather compressed, in the largest specimen narrower than in the smaller ones. Fig. 8 (Pl. I.) represents one of the smaller ones. Valves white, almost entirely smooth, when seen with a lens there appear fine striæ radiating from the umbones. Peduncle very short.

Scutum.—Apex pointed, ridge running to the umbo faint; basal margin very short, carino-tergal margin of a curious concave shape, being hollowed out for the reception of the widened part of the carina; angle formed by the basal and the carino-tergal margins very sharp. A very characteristic swelling is described where the scutum and the carina meet near the basal margin. There is no trace of an internal basal rim, and the teeth near the umbo are not very strong. The convexity of both valves is quite equal.

Tergum with the occludent margin straight and the basal angle truncated, almost parallel to the occludent margin.

Carina short, strongly curved, upper part much narrower than the lower part; externally carinated, internally—especially in the undermost part—distinctly concave; the basal and broadest part forms a kind of fork, which is not embedded in the membrane of the peduncle (Pl. VII. fig. 6).

Peduncle very short, about one-eighth the length of the capitulum, indistinctly ringed.

Mouth.—*Labrum* with a row of very small teeth on the crest and palpi, with a tuft of slender hairs internally. *Mandibles* with four teeth and an inferior apex, which, when seen under the microscope, terminates in three very small points. In the only specimen, the mouth of which I have investigated, the mandible of the right side is formed as figured in Pl. I. fig. 9, that of the left side (Pl. VII. fig. 7) having three teeth only, the fourth forming with the inferior apex a single process terminated by several small teeth. *Maxilla* (Pl. I. fig. 10) with three stronger spines on the upper angle; the notch or depression beneath the angle bears no spines; beneath the depression four slender spines are inserted, the inferior upraised part is armed with a double row of longer and stronger spines. The surface of the maxilla towards the side bearing these spines is furnished with numerous slender hairs, of which, as a rule, two, three, or four, stand close to one another.

Cirri.—Posterior cirri with segments bearing the same number of cirri as in *Pœcilasma kaempferi*, Darwin, viz., five pairs, the lowest pair being very minute; the segments elongated. First cirrus standing not far from the second (Pl. II. fig. 1), rami nearly equal, truncated at the extremity, rather thick. Second cirrus more than twice as long as the first, anterior ramus not thicker, but considerably shorter than the posterior ramus; the difference in the number of segments (18 and 15) being by no means so great as that in the length of the different segments.

Caudal appendages with about one-fourth the length of the pedicel of the posterior cirrus with long bristles at the extremity, and with the sides naked.

Ova.—Long, oval, and pointed, their length (0·26 mm.) being exactly two and a half times their breadth.

Penis clothed with very fine hairs, and bearing a tuft of somewhat stronger ones at the extremity.

Size.—The capitulum of the largest specimen 14 mm. long. This specimen was furnished with ovigerous lamellæ.

This species was collected on two different occasions during the cruise of the Challenger:—Station 24, March 25, 1873, off Culebra Island (West Indies); depth, 390 fathoms; bottom, mud. One small specimen. Station 344, April 3, 1876, off Ascension Island (Atlantic Ocean); depth, 420 fathoms; hard ground. Three specimens and two very small ones, attached to a Coralline.

Pœcilasma gracile, n. sp. (Pl. II. figs. 2–4).

Valves five; carina terminating downwards, neither truncated nor in an embedded disc, but considerably enlarged and keel-shaped. Tergum with the basal point truncated and almost parallel to the occludent margin. Tergo-lateral margin rounded. Notch behind the stronger spines at the upper side of the maxillæ without spines. Caudal appendages with long spines at the extremity.

General appearance.—Capitulum about twice as long as it is broad, compressed. Valves white, distinctly striated.

Scutum with the apex pointed, with a distinct ridge running to the umbo; basal margin equalling the breadth of half the carina near its basal extremity. Carino-tergal margin distinctly divided into a carinal and tergal portion. The carinal portion is convex and rounded, the tergal portion straight. The interior structure of the scutum could not be studied, as I wished to keep the capitulum as a whole.

Tergum basally truncated, flat, oblong, much like that of *Pœcilasma kaempferi*, Darwin.

Carina very narrow and flat at its superior extremity, considerably enlarged downwards and keel-shaped. The dorsal margin runs downwards over the extremity of the peduncle, the base of the carina forming nearly a right angle with the basal margin of the scutum.

Peduncle about one-third of the length of the capitulum.

Mouth.—*Labrum* (Pl. II. fig. 3) with a row of small teeth on the crest and palpi as in the other species of the genus. The *mandibles* (Pl. II. fig. 4) have four teeth, and the inferior angle terminates in two small points when seen under the microscope. *Maxillæ*

resemble almost exactly those of the foregoing species; beneath the notch there is one slender spine, while numerous stronger spines are inserted in a double row on the inferior upraised part.

Cirri.—Posterior pair with segments bearing as a rule four pairs of spines, the lowest pair of which is very minute, the second pair minute. Dorsally at the limit of two segments, one stronger and two or three smaller spines are inserted. First pair of cirri standing far separated from the second; rami about equal in length and thickness, less than half as long as those of the second cirri. Second cirrus with anterior ramus not thicker and only a trifle shorter than the exterior ramus; the interior has fourteen, the exterior fifteen segments. Both rami of third cirrus have a longitudinal row of slender spines reaching to about the eighth segment.

Caudal appendages about one-fourth of the length of the pedicel of the last cirrus, with a row of slender spines at the extremity.

Penis not very hairy.

Size.—Entire length 8 mm., the capitulum measuring nearly 7 mm.

During the Challenger Expedition one specimen was collected at Station 164A (off Sydney, Australia); lat. 34° 13′ S., long. 151° 38′ E; depth, 410 fathoms; bottom, grey ooze.

Dichelaspis, Darwin, 1851.

Darwin gives the following diagnosis of this genus:—Valves five, generally appearing like seven, from each scutum being divided into two distinct segments, united at the rostral angle; carina generally extending up between the terga, terminating downwards in an embedded disc, or fork, or cup. Mandibles with three or four teeth; maxillæ notched, with the lower part of the edge generally not prominent; anterior ramus of the second cirrus not thicker than the posterior ramus, nor very thickly clothed with spines; caudal appendages uniarticulate, spinose.

As far as the animal's body is concerned, there is no important difference between this genus and *Pœcilasma*. It has been separated by Darwin from the latter genus, "being so easily distinguished externally, that I have thought it a pity to sacrifice it." The characteristic form of the scutum and the carina, which runs up between the terga, make it easy, no doubt, to distinguish this genus from the other Lepadid-genera, to which in other regards it shows great affinity.

Darwin describes five species of this genus. Three species more have since been described. In the first place, *Dichelaspis darwinii*, de Filippi, from the Mediterranean, then *Dichelaspis neptuni*, Macdonald, sp., from Moreton Bay, Australia. This second species has been introduced into science under the name *Paradolepas neptuni*. However there can be no doubt, I believe, but that it belongs also to the present genus. I even

think that it is more nearly related to *Dichelaspis lowei*, Darwin, than any of the other species; it corresponds to this species and to *Dichelaspis darwinii*, Filippi, in the form of the carina. The third species is *Dichelaspis aymonini*, Lessona et Tapparone-Canefri, from Japan. So we have eight species, which all inhabit eastern and western warmer oceans in the northern hemisphere (Madeira, Mediterranean, off Borneo, China Sea, Japan coast, Indian Ocean, &c.). They were found attached to Sea-snakes, Crustaceans, horny Corallines, &c. The individuals of most species seem to be rare, as Darwin suggested. About their bathymetrical distribution almost nothing is known.

To this genus belongs also, I believe, the species before me. It differs from the typical species as described and figured by Darwin in the extent to which the valves are separated from each other, and in the form of the scutum. In both regards the new species is intermediate between *Pœcilasma* and *Dichelaspis*. However, the carina extending up between the terga, and being much bowed, gives it in a striking manner the appearance of the species of *Dichelaspis;* especially to that of *Dichelaspis orthogonia*, Darwin, the present species shows a considerable resemblance.

For the determination of the species known at present, I insert the following table:—

Dichelaspis.

1. Carina terminating in a disk.	
i. Basal segment of the scutum twice as wide as the occludent segment, ...	*Dichelaspis warwickii*, Gray, sp.
ii. Basal segment narrower than the occludent segment, ...	*Dichelaspis grayii*, Darwin.
iii. Basal segment much narrower and about half as long as the occludent segment, . .	*Dichelaspis pellucida*, Darwin.
2. Carina terminating in a fork.	
i. Basal segment of the scutum directed towards the centrum of the capitulum, . . .	*Dichelaspis neptuni*, Macdonald, sp.
ii. Basal segment of the scutum running parallel to the lower margin of the capitulum.	
(*a*) Capitulum almost as long as broad.	
α Tergum triangular, . . .	*Dichelaspis aymonini*, Lessona.
β Tergum divided by a deep notch, .	*Dichelaspis darwinii*, Filippi.
(*b*) Capitulum more than once and a half as long as it is broad, . . .	*Dichelaspis lowei*, Darwin.
3. Carina terminating in a cup.	
i. Scutum divided into two distinct segments, .	*Dichelaspis orthogonia*, Darwin.
ii. Scutum with a notch only and indistinctly divided	*Dichelaspis sessilis*, n. sp.

Dichelaspis sessilis, n. sp. (Pl. II. figs. 10–12).

Interspace between the scutum and the two other valves not so considerable as in the other species, the scutum being only indistinctly divided in two segments. Basal segment

short and pointed towards the extremity. Terga triangular, basal angle pointed. Carina terminating downwards in a small cup. Mandibles with four teeth; maxillæ with the inferior part beneath the notch rather prominent. Caudal appendages.

General appearance.—Capitulum much compressed, about twice as long as broad. Valves separated by a very thin membrane, which can be followed over the surface of the valves.

Scutum formed of a rather broad part towards the occludent margin, and a very small and short piece along the basal margin. A not very distinct ridge runs from the apex to the umbo; the surface shows faint traces of radiating lines.

Tergum triangular; two occludent margins, the one long and slightly arched, the other short, meeting the former at a rounded angle; carinal margin almost straight, slightly hollowed a little above the middle; scutal margin nearly straight, meeting the carinal margin at a rather pointed angle.

Carina large and much bowed, extending up between the terga; externally with a flattened central ridge, broad at the superior extremity and tapering towards the point, where the carina is strongly curved inwards. The inferior cup-shaped part I feel unable to describe, as I have not separated this valve from the others, which alone could give full information, but which would have destroyed the specimen. Its external appearance may be judged from the figure (Pl. II. fig. 10).

Peduncle extremely short and rather narrow; its surface being distinctly furrowed at the surface.

Mouth.—Mandibles (Pl. II. fig. 11), with four teeth and the inferior angle bifid. *Maxillæ* (Pl. II. fig. 12), with four spines above the notch, two small ones in the notch, and a double row of spines on the rather prominent inferior part.

Cirri.—First pair far removed from the second pair. Thickness of the rami almost the same; length differing a little, the posterior ramus being two segments longer than the anterior one. Number of segments of both rami of the second pair not very considerable (11 and 12), the posterior one with twelve segments being the longer. Segments as a rule furnished with four or five pairs of spines, the first pair of each segment being much smaller than the following ones. The inferior segments, moreover, are furnished with a longitudinal row of small spines always transversely directed. The inferior segments of the rami of the sixth cirrus are furnished with six pairs of spines, the superior ones with five, the last segments with even fewer pairs.

Caudal appendages.—Thin, narrow, about half as long as the pedicels of the sixth cirrus; a tuft of long bristles, reaching farther still than the extremity of the pedicels, on the summit.

Penis slightly hairy on the inferior part, the superior part wanting.

Size, $7\frac{1}{2}$ mm.

The only specimen brought home by the Challenger is attached to the spine of an Echinid, and was dredged in the Atlantic,—near the Azores, at Station 73, June 30, 1873; lat. 38° 30′ N., long. 31° 14′ W.; depth, 1000 fathoms; bottom temperature, 3°·7 C.; bottom, Globigerina ooze.

Observations.—*Dichelaspis sessilis* is the first instance of a *Dichelaspis* dredged up from a considerable depth. Two other species, however (*Dichelaspis lowei* and *Dichelaspis warwickii*), were found attached to crabs, which may or may not have been inhabitants of deep water. One species, *Dichelaspis orthogonia*, habitat unknown, was found "apparently" attached to a horny Coralline, which perhaps was procured from a considerable depth. Two species were found attached to the skin of sea-snakes, and, therefore, may be considered as surface-animals.

N.B.—Small specimens of a Foraminifer (*Discorbina* ?) were found attached to the capitulum of *Dichelaspis sessilis*.

Megalasma, n. gen.[1]

Valves five, approximate; carina extending only to the basal points of the terga, with its lower end truncated and very wide. Scuta triangular, with their umbones at a considerable distance from the rostral angle. Mandibles with four teeth; maxillæ slightly notched, with the lower part of the edge slightly prominent; anterior ramus of the first cirrus much thicker than the posterior ramus; the two rami of the second cirrus nearly equal; caudal appendages uniarticulate, short and spinose at the extremity.

This genus is nearly related to *Pœcilasma*. However, my reasons for separating it from that genus are, I think, as important as those for separating *Pœcilasma* and *Lepas*, or *Pœcilasma* and *Dichelaspis*. The new genus must be placed in the same Family as these genera, being easily distinguished from them by the form of the scutum and the width of the carina. With regard to the carina, *Pœcilasma carinatum*, which I described on p. 44, shows a considerable resemblance to *Megalasma;* and to this affinity the form of the scutum only partly opposes itself. For in *Pœcilasma carinatum* the basal margin, which in *Megalasma* is totally wanting, has become a great deal shorter than in the other species of the same genus; so it seems that *Pœcilasma* leads to *Megalasma* through *Pœcilasma carinatum*.

The animal's body only slightly differs from that of *Pœcilasma*, the most remarkable difference consisting in the unequal thickness of the rami of the first cirrus.

As only one species of the new genus is known, I think it better not to enlarge upon the description of the genus. Its habits and distribution will also be given under the head of the species.

[1] From μέγας, great, and ἔλασμα, plate or valve.

Megalasma striatum, n. sp. (Pl. II. figs. 5–9; Pl. VII. figs. 8–9).

With the characters of the genus.

General appearance.—The capitulum is large and resembles much in outline the shell of a Lamellibranchiate Mollusk. The short peduncle is quite covered by the capitulum. The shape of the capitulum is very characteristic; it is ovate, with both extremities pointed, the occludent margin being almost exactly of the same length as the carinal margin. All the valves are beautifully and distinctly striated and covered by membrane, which is not very persistent, except over the lines separating the valves.

Scutum triangular, or more exactly still, having the form of a sector of a circle, a little more than 90°. The two radii are represented by the tergo-lateral and carinal margins of the valves. The basal margin seems to be totally wanting; most probably, however, it is represented by the undermost part of the occludent margin. The scutum is divided into two unequal parts by a very prominent ridge which runs from the angle (formed by the tergo-lateral and carinal margins) to the occludent margin, which it meets at one-fifth of the whole length of the occludent margin. The two unequal parts of the scutum separated by this ridge have their lines of growth in a very different direction; those of the larger part run exactly parallel to the tergo-lateral margin, those of the smaller undermost part converge to meet at the angle formed by the carinal and occludent margins. From the point where the ridge meets the occludent margin to its apex, the scutum shows externally a prominent and flattened border, much broader at the apex than at the other extremity, and as far as this border goes, a margin distinctly bent down, which together probably represent the small part, that, in the nearly related genera of Lepadids, is situated between the occludent margin and the ridge which runs from the apex to the umbo. Internally (Pl. VII. fig. 8), this margin projects as a very prominent ridge downwards, terminating in both scuta in a very large tooth. This is situated at a distance of about one-fifth of the length of the occludent margin from the angle formed by the occludent and carinal margins, and has a flat surface of a long oval form; on both two small notches are easily observed. As shown by a dorsal (carinal) view of the animal (Pl. II. fig. 6), the undermost part of the scutum is considerably expanded on both sides. Parallel to the lines of growth the scuta are distinctly striated, the surface of the different stripes being again transversely, but very minutely striated. In my figure (Pl. II. fig. 5) these latter striæ have not been represented. Internally, near the carinal margin, a very small notch is visible for the reception of a tooth of the carina; the tergo-lateral margin shows an indistinct tooth near both extremities; these, of course, serve also for the attachment of the other valves. The smaller undermost part of the scutum has on its surface still another ridge, which describes with its continuation situated on the carina half a circle, as will be easily understood from fig. 5 on Pl. II.

Tergum triangular, the occludent margin is only a little longer than the scutal margin. The occludent margin shows the same flattened border as the larger and uppermost part of the scutum; on the contrary (as seen from Pl. VII. fig. 8), the bent-down margin on the occludent side is not represented. As shown by fig. 6 (Pl. II.) such a bent-down margin is very strongly represented along the carinal margin of these valves, where it forms the continuation of the much flattened dorsal margin of the carina. Basal angles pointed. The surface of the terga shows the same striation as that of the scuta. Its lines of growth run parallel to the scutal margin.

Carina externally almost entirely resembling the tergum (or the continuation of the two terga). It is broad, especially towards its basal end, and much arched, running up just between the basal ends of the terga. As I have already said, the dorsal margin is much flattened, being broadest towards the upper end and gradually diminishing towards the lower end. This dorsal flattened part is slightly but distinctly furrowed in a longitudinal direction, the furrow forming the continuation of the margin between the two terga. The surface is striated as in the other valves. The base is abruptly truncated. At the inferior side the carina is barely concave, the undermost part being separated from the larger uppermost part by an incomplete partition of a semi-annular form. The latter resembles much the internal structure of the carina of *Pœcilasma carinatum* (Pl. VII. figs. 6 and 8).

Peduncle very short, totally covered by the capitulum.

Mouth.—Labrum with a row of teeth beneath the crest, which is bullate, and a pair of slender palps with hairs at the internal surface (Pl. II. fig. 7). *Mandibles* (Pl. II. fig. 8) with four teeth, the first standing a little way apart from the others, the fourth close to the inferior angle, which is very little developed, and terminates in two microscopical points. *Maxillæ* (Pl. VII. fig. 9) with two larger and two smaller spines on the upper angle; notch beneath the upper spines very large, and furnished with two not very long and not very thick spines. Inferior upraised part with a double row of rather long and thin spines. The whole maxilla has a very striking triangular form.

Cirri.—First pair (Pl. II. fig. 9) far removed from the second pair, and about half their length. Anterior ramus thicker than the posterior, the latter a little longer. Both rami have eight segments. Numerous spines along both sides of the different segments, and especially at the exterior face of the longest and thinnest ramus.

Second pair with the anterior ramus a little shorter but not thicker than the posterior, the number of segments of the longest ramus being thirteen, of the shortest eleven. On most segments the number of pairs of spines along the margin is five. Of these the first pair is extremely small, the second a little stronger, the three others of normal length and strength. The anterior ramus, moreover, shows transverse rows of about four spines on the lines separating the segments.

Sixth pair with equal rami and both of thirteen segments. The arrangement of the

spines is as follows: there are five pairs along the anterior margin, the first pair very minute, the second pair smaller than the three other pairs, and tufts of, as a rule, three spines on the posterior margin on the limit of two segments. On the seventh and eighth segments of the anterior ramus a single spine is situated nearly in the middle. Pedicels of the cirri not very long, rami rather long and slender; second segment of the pedicels slightly protuberant, those of the rami not protuberant but elongated.

Caudal appendages.—Short, not quite one-third the length of the pedicels of the sixth cirrus, terminating rather abruptly and broad, with a row of strong and slender spines at the extremity.

Ova unknown.

Size.—The largest specimen collected measures 11 mm., the next largest measures 7 mm.

Number of specimens.—In all six specimens and two extremely small ones, measuring 1 mm. only, were collected.

Habitat.—This species lives attached to the spines of an *Echinus*, and was dredged at Station 204, November 2, 1874; lat. 12° 43′ N., long. 122° 10′ E.; depth 100 and 115 fathoms; bottom, mud. (Philippine Archipelago.)

Conchoderma, Olfers, 1814.

In the collections made during the cruise of the Challenger, the genus *Conchoderma* is represented by the species *Conchoderma virgatum*, Spengler, and by some small specimens which were found attached to a turtle, and which, according to Darwin, is a variety of *Conchoderma virgatum*.

As far as our knowledge goes, only two really different forms, true species therefore, can be distinguished in this genus. They are the *Conchoderma auritum*, Linn., sp., common on whales—when it is often found attached to *Coronulæ*—and the above-named *Conchoderma virgatum*, Spengler. A third species, *Conchoderma hunteri*, Owen, has been described by Darwin from specimens preserved in spirit in the museum of the College of Surgeons. This may be a different species; but I think on account of its strong resemblance to the variety *Conchoderma virgatum*, var. *chelonophilus*, Leach, and the complete conformity of all its interior characters to those of *Conchoderma virgatum*, it would be a great deal more rational to regard it also only as a variety of *Conchoderma virgatum*.

Gerstäcker (Bronn, "Classen und Ordnungen," *loc. cit.*, p. 535) says that the genus contains five species: besides the three species of Darwin he mentions *Conchoderma gracile* of the European seas (p. 577), and *Conchoderma coronularium* (p. 578) from the west coast of South America. Of these the first is a species of Heller, who observed it in the

Adriatic on the gills of *Maja squinado*. However, there can be little doubt but this is indeed a species of *Dichelaspis*, and I even feel convinced that it is the same as *Dichelaspis darwinii*, Filippi.[1] *Conchoderma coronularium* I have not been able to make out; whether it corresponds to *Conchoderma auritum*, Linn, sp., or perhaps represents a different species, I cannot say. Perhaps it is the same as *Otion stimpsoni*, Dall, which species is founded upon a very imperfect description without figures by Mr. Dall.[2] This species has, according to this author, only the scuta, whereas typical specimens (according to Leach, and also according to Darwin) are furnished with five valves (two scuta, two terga, and a carina). Darwin says, however, that in *Conchoderma auritum* the terga and the carina are often absent, and this seems especially to be the case in the large specimens which are found attached to *Coronulæ* on whales. Now, the specimens which Mr. Dall took from *Coronula* (sessile on the "Humpback") had a length of almost 5 inches (peduncle 2·8 inch, body 2·16 inch); I therefore think it very probable that the species of Mr. Dall is the same as *Conchoderma auritum*, which, according to Mr. Darwin, is a world-wide and extremely common species.

The characters of the genus are the following:—Capitulum almost totally membranous; valves two to five, minute, remote from each other; scuta with two or three lobes, with their umbones in the middle of the occludent margin; carina arched, upper and lower ends nearly alike. Filaments[3] numerous, not only two pairs seated beneath the basal articulations of the first pair of cirri, but also on four or five anterior pairs; mandibles with five teeth, finely pectinated; maxillæ with distinct steps; caudal appendages none.

No fossil remains of this genus are known. The smallness of the calcified valves may possibly be the cause of this; it would be rather rash in my opinion to conclude that it is a genus of recent occurrence only, because it has not as yet been found in fossil deposits

Both species are extremely common, and have, as Darwin says, a world wide distribution. They live attached to floating objects, bottoms of ships, sea-weed, turtles, whales, &c. They can be distinguished from each other in the following way:—

[1] Of this species Heller gives the following description:—"Stiel vom Köpfchen deutlich abgesetzt, bis 2½‴ lang, das Köpfchen von fast gleicher Länge, umgekehrt herzförmig, hinten breit, nach vorn und unten verschmälert. Der Mantel ist dünn, halbdurchsichtig, gelblichweiss, nur durch einige kleine Kalkreifen gestützt. Die Carina erscheint ehr dünn, verläuft am obern stark gekrümmten Rande nach hinten, wo sie sich in zwei Schenkel theilt, die beiden schmalen Scuta sind ebenfalls zweischenkelig, die Schenkel unter einem ziemlich spitzen Winkel vereinigt. Auch finden sich nach vorn hin zwei kleine hakig gekrümmte Tergalstücke in der Mantelhaut. Der Körper selbst ist am Vorderende in ein hakig gekrümmtes Rostrum verlängert.

[2] *Proc. Calif. Acad. Nat. Sci.*, vol. iv. 1873, p. 301.

[3] Gerstäcker (*loc. cit.*, p. 535), calls the filaments of *Conchoderma* filamentary gills (geisselartige Kiemen). I do not believe, however, that it is proved that these structures are respiratory.

Conchoderma.

1. Filaments attached to the pedicel of the second cirrus, capitulum with two tubular ear-like appendages, scuta bilobed, ...	*Conchoderma auritum*, Linn., sp.
2. No filaments attached to the pedicel of the second cirrus, capitulum without tubular ear-like appendages, scuta three-lobed, ...	*Conchoderma virgatum*, Spengler, sp.

Conchoderma virgatum, Spengler, sp.

Lepas virgata, Spengler, Skrifter Naturh. Selskab. I. 1790, Tab. vi. fig. 9.
Conchoderma virgata, Darwin, Lepadidæ, 1851, p. 146.

Of this species Darwin gives the following definition, which I think is quite sufficient to characterise it:—Scuta three-lobed; terga concave internally, with their apices slightly curved inwards; carina moderately developed, slightly curved; peduncle blending into the capitulum. No filament attached to the pedicel of the second cirrus.

I do not wish to add anything to the very detailed description which Darwin gives of this species. To make a comparison of this species with the variety *chelonophilus* possible, I made a preparation of the parts which constitute the mouth. Of the maxillæ Darwin says that they have five steps; sometimes each step commences with a spine rather larger than the others; at the upper angle there are two large unequal spines (neither pectinated), with a third, longer and thinner, situated a little below. That the large spines of the upper angle are not pectinated has been pointed out by Darwin, as it furnishes a remarkable difference from the spine of the maxilla of *Conchoderma auritum*. I am obliged, if not to deny the value of this characteristic, at least to diminish it. When studied with an ordinary pocket lens the same spine appears in *Conchoderma virgatum* to be distinctly pectinated near its base.

Two specimens of this species were taken from the screw of the Challenger at St. Vincent, Cape de Verdes, on the 25th April 1876, on the ship's voyage homeward. According to Darwin, the growth of this species is very rapid.

Conchoderma virgatum, var. *chelonophilus*, Leach (Pl. II. figs. 13–15).

Conchoderma virgata, var. *chelonophilus*, Leach, Darwin, Lepadidæ, 1851, p. 151.

Though the capitulum of this form differs considerably in appearance from that of the common *Conchoderma virgatum*, Darwin regards it only as a variety of that species. This he does because all parts of the animal, and especially the mouth and the cirri, are quite identical in the species *Conchoderma virgatum*, and in the present form. Perhaps, Darwin says, this variety may turn out to be a true species; but as our knowledge since Darwin published this supposition has been almost stationary, I think it safest to follow his example. However, I am willing to confess that, if no intermediate forms exist, in

my opinion the smallness of the form, the totally different shape of the capitulum, and its living exclusively on the carapace of turtles are sufficient characters for regarding it as a true species. I give a figure of this form on Pl. II. fig. 13. It is represented by a considerable number of specimens, which are all very small, none having a capitulum of the size of half an inch, the greatest length observed by Darwin. The parts of the mouth are exactly as in *Conchoderma virgatum*. In one of the specimens I investigated, however, the left hand mandible is malformed in a curious way (having seven teeth without the inferior angle), whereas the right hand mandible looks exactly normal. I have figured both mandibles on Pl. II. figs. 14 and 15. These parts, as is well known, often show anomalies of more or less importance.

These specimens were taken from the carapace of a *Chelone*, between Gibraltar and Madeira, January 31, 1873. Darwin says that it is only found on the *Testudo caretta;* whether this is the only turtle on which it lives I cannot say. With regard to the smallness of this variety, I must add that I got specimens from the Royal Museum of the Netherlands (labelled "on *Chelone*, lat. 35° N., long. 14° W."), which were much larger, and even larger than the size given by Darwin (13 mm.), the length of the capitulum being almost 18 mm.[1]

Fresh evidence of the great variability of this species is furnished by the study of specimens of this species from the Gulf of Naples. It is the form of the valves, and especially of the scutum, which in these specimens shows a very interesting deviation from the typical form, the three lobes of the scutum not being broad but narrow, as in the *Conchoderma hunteri*, Owen, sp., and the carina which is also much more slender. As this very narrowness of the valves is the most distinctive character by which the latter species can be distinguished from *Conchoderma virgatum*, the study of the Mediterranean form has confirmed my opinion that it is by far the safest way at present to accept only two species, and to consider all the other forms as varieties.

Alepas, Sander Rang, 1829.

With the exception of one species, *Alepas parasita*, Sander Rang, which measures two inches, all the species of this genus are rather small. They are found attached to various living objects, fixed or floating. *Alepas parasita* has been always taken on Medusæ, *Alepas minuta*, Philippi, lives attached to a *Cidaris*, *Alepas cornuta* to an *Antipathes*, *Alepas tubulosa*, Quoy et Gaimard, to a living *Palinurus*.

Off New South Wales, the Challenger collected some specimens of a species of this genus, which were attached to the spines of an Echinid (*Phormosoma*).

The little group of Lepadids which constitute this genus is sharply defined by the following characteristics:—The capitulum is either without valves, or with horny almost

[1] The size is no doubt a very bad characteristic. I received specimens from the Gulf of Naples of *Conchoderma virgatum* as well as of *Conchoderma auritum*, both remarkable for their smallness.

hidden scuta. Filaments one pair, seated beneath the basal articulations of the first pair of cirri; the mandibles have two or three teeth, the maxillæ are notched, the caudal appendages are multi-articulate.

This genus forms the transition from those with distinct and well-developed valves to the genus *Anelasma*, which is quite destitute of valves. In those species which are furnished with scuta, these valves resemble in form those of *Conchoderma*, and according to Darwin it shows also some affinity to this genus by the ovarian tubes in *Alepas cornuta* surrounding the capitulum. According to this same author, *Alepas* has perhaps a closer affinity to *Ibla*. But as I do not know this genus from personal investigation, I think it better to refer to the work of Darwin.

This genus has a world-wide range, though represented by a few species only, and never by a great number of specimens. As to its range in depth, almost nothing is known as yet. As a rule, they inhabit either the surface of the sea or rather shallow water. The new species, which will presently be described by me, is the first taken from so considerable a depth as 410 fathoms.

To determine the species of this genus, I have composed the following table :—

Alepas.

1. Scuta horny, covered by the integument of the capitulum.
   - i. Orifice one-third of the length of the capitulum; total length not quite half an inch,[1] . . *Alepas minuta*, Philippi.
   - ii. Orifice two-thirds of the length of the capitulum; total length two inches, . . . *Alepas parasita*, Sander Rang.
2. Scuta wanting; orifice slightly protuberant.
   - i. Inner rami of the fifth and sixth cirri rudimentary, *Alepas cornuta*, Darwin.
   - ii. Inner rami of the fifth and sixth cirri normal, . *Alepas pedunculata*, n. sp.
3. Scuta wanting; orifice tubular, protuberant, . . . *Alepas tubulosa*, Quoy et Gaimard.

Alepas pedunculata, n. sp. (Pl. III. figs. 1–5; Pl. VII. figs. 10, 11).

Orifice slightly protuberant, small. Scuta wanting, capitulum globular, without projections along the carinal margin. Peduncle a little longer than in the other species of the genus. Outer maxillæ with the inner bristles divided into two groups; segments of the posterior cirri not very numerous, inner rami of the fifth and sixth cirri as strongly developed as the outer rami.

Capitulum globular, with the carinated edge smooth, entirely destitute of valves. Colour, flesh-colour, dotted over with small red spots. Orifice slightly projecting or tubular, parallel to the longitudinal axis of the peduncle, with the edges sinuous. As

[1] Darwin (*loc. cit.*, p. 161), says that the total length of the largest specimen he examined was about one-fourth of an inch. I got specimens from the Gulf of Naples, the largest of which was almost 12 mm. In these larger specimens the scutum is almost entirely hidden.

in *Alepas cornuta*, Darwin, the orifice appears more sinuous than it really is, from the convexity of the part of the capitulum immediately beneath the orifice.

Peduncle almost as long as the capitulum, the one insensibly passing into the other; the peduncle, however, is much narrower than the capitulum, and is furnished with a swelling towards its upper end. Colour and red spots as in the capitulum.

Size.—The largest specimen, including the peduncle, was 13·5 mm. in length, and 5 mm. across the capitulum.

Filamentary appendages.—One on each side, not very short, tapering and pointed; seated on the posterior margin of the swelling beneath the basal articulation of the first cirrus (Pl. III. fig. 4).

Mouth.—Labrum (Pl. VII. fig. 10) not very prominent or bullate, crest with a row of blunt bead-like teeth, and externally to these there are no bristles. *Palpi* triangular, by no means so narrow as those of *Alepas cornuta*, thickly closed with doubly serrated bristles along their inner margins. *Mandibles* (Pl. III. fig. 2) with three teeth, the third has a toothed edge as in *Alepas minuta* and in *Conchoderma;* inferior angle rather stout and also furnished with teeth. Both sides covered with bristles, strongly projecting over the hinder margin of the inferior angle. *Maxillæ* (Pl. III. fig. 3).—Upper extremity with one very strong and two rather smaller spines. Beneath these there is a somewhat indistinct notch, in which four or five small spines are seated. Inferior part not very prominent, with numerous doubly arrayed spines, two of which are much stronger than the others. Steps not distinct. *Outer Maxillæ* (Pl. VII. fig. 11) with a semicircular outline; serrated bristles in front indistinctly divided into two groups.

Cirri not very long, slightly curled towards the extremity. Pedicels in proportion long, rami rather short. Segments short, inconsiderably produced towards the extremity. *First cirrus* (Pl. III. fig. 4) close to the second, top of its pedicel on a level with the top of the pedicel of the second cirrus. Rami not very short, more than three-quarters of the length of those of the second cirrus, unequal, the anterior ramus being a little longer than the posterior ramus; the posterior contains seven, the anterior eight not very distinct segments. Their form is nearly quadrangular and not protuberant. The anterior and longer ramus is a little thicker than the other. Spines very numerous on the outer surface, and placed on the margins of the segments only at the inner side. Those of the two last segments are a little shorter and more robust. *Second cirrus* with almost equal rami of fourteen short segments. Pedicel long as in the other cirri. Bristles forming rows at the outer margin of each segment, and forming tufts at the slightly protuberant anterior side of each segment. The *sixth cirrus* (Pl. III. fig. 5) has also fourteen segments in both rami; the rami are equal, and show the same arrangement of the bristles as the second cirrus. The bristles at the hinder side of each segment are longer than those placed at the front side.

Caudal appendages (Pl. III. fig. 5), very long and very slender; they reach as far

as the extremity of the third segment of the hinder ramus of the sixth cirrus, and are ten-jointed, with a long pedicel. A row of very minute bristles is placed round the upper margin of each segment, a somewhat longer tuft is inserted on the slender terminal segment.

Penis distinctly segmented or ringed. Short and very thick, with numerous slender and isolated hairs, and a tuft of longer and stouter ones at the extremity.

This species was found on the spines of a deep-sea Echinid *Phormosoma hoplacantha*, A. Ag.; it was dredged during the cruise of the Challenger at Station 164A, June 13, 1874; lat. 34° 13′ S., long. 151° 38′ E.; depth, 410 fathoms; bottom, grey ooze. Off New South Wales.

Affinities.—It is possible that *Alepas tubulosa*, Quoy et Gaimard, is the same species as the one collected by the Challenger. However, I prefer to consider the latter as a different species, because the former has a distinctly tubular orifice, which is not the case with my *Alepas pedunculata;* and as regards other characteristics, the imperfect description published in the voyage of the "Astrolabe" leaves us quite in the dark. The form of the capitulum with the slightly protuberant orifice no doubt shows a certain resemblance to *Alepas cornuta*, Darwin. But the latter species is easily distinguished from mine—(1) by the flattened projections along the carinal margin of the capitulum; (2) by the rudimentary condition of the inner rami of the fifth and sixth cirri; and (3) by the large number of the segments of the posterior cirri.

Scalpellum, Leach, 1817.

Darwin's diagnosis is as follows:—Valves twelve to fifteen in number; latera of the lower whorl four or six, with their lines of growth generally directed towards each other; sub-rostrum very rarely present; peduncle squamiferous, most rarely naked. Filamentary appendages none; labrum with the upper part highly bullate; trophi various; olfactory orifices more or less prominent; caudal appendages uniarticulate and spinose, or none.

This at least is the diagnosis for the hermaphrodite and female specimens, to which diagnosis Gerstäcker adds that the mandibles have three or four teeth, that the first cirrus is seated far distant from the second, and that the second and third cirri have the rami more thickly clothed with spines than the three posterior cirri.

The males (Darwin) are parasitic at or near the orifice of the sack of the female or of the hermaphrodite; thorax enclosed within a capitulum, furnished with three or four rudimentary valves, or with six perfect valves; peduncle either short and distinct, or confounded with the capitulum; sometimes mouth and stomach absent, and cirri non-prehensile; sometimes mouth and cirri normal.

Darwin (1851) has described six recent species belonging to this species; Gerstäcker

(1869–70) states the number of recent species is seven, one species (*Scalpellum stroemii*) having been described in 1858 by M. Sars. To this number four species were added by Prof. G. O. Sars (1877 and 1880), and one by Prof. Wyville Thomson (*Scalpellum regium*), from specimens collected during the cruise of the Challenger. The total number of recent species hitherto known, therefore, amounts to twelve. Though all the records of zoological literature have been carefully searched, I do not feel sure that this number really represents the total of at present known recent species; especially since it appears from the collections made during the cruise of the Challenger that the number of existing species greatly exceeds the above named number. More than forty species will later on be described as new to science! Yet I need hardly repeat here that it is often an utter impossibility to avoid describing a species as new, the description of which has been published perhaps long ago in the Transactions of some Asiatic or Australian Society, the existence of which has not even come to the knowledge of the recorders of zoological literature.

The majority of the new species are inhabitants of deep-water. *Scalpellum* seems to be the only genus of Cirripedia which is often met with in the great depths of the ocean. This strikingly coincides with the common occurrence of this genus in the fossil deposits, especially in secondary strata (Cretaceous period). However, the genus *Pollicipes* is there to show that we must not attach too much value to this coincidence (see p. 26). *Pollicipes* is the oldest known fossil genus, all its species live exactly under the same circumstances as the species of *Scalpellum*, viz., attached to various objects which are found on the bottom, but not a single species has been hitherto taken from any considerable depth!

The same observation which Darwin made with regard to the number of specimens of Cirripeds during the Cretaceous period may be made for the living species of this genus; although, Darwin says, the number of species was considerable, the individuals were mostly rare. Now the number of species of the genus *Scalpellum* represented in the Challenger collections amounts to forty-three, and of these twenty-six are represented by a single specimen only, four are represented by two, five by three, two by four, and six only by more than four specimens.

The great number of species in this genus suggested the idea of dividing it into smaller genera. After careful examination this idea, however, has been given up, as all the species in essential characters correspond as closely, even more closely, with one another than in any other genus of Cirripedia. Nor has it been an easy matter to arrange the species in a natural way, especially because I was not at liberty to make preparations of the parts of the mouth and of the cirri of those species which are represented by single or by two specimens only. For this reason, as well as for the sake of practical utility, I have made use of externally visible characters only, such as are furnished by the condition, number, and shape of the different valves of the capitulum, in order to differentiate the various species in the table which follows.

In the first place, I separate those species which have imperfectly calcified valves from those with perfectly calcified ones. Whereas the first division of the genus only contains at present five species, the latter numbers forty-seven. These may be subdivided by the aid of the form of the carina, viz.: into species with a carina a portion of which projects freely, into species with an angularly bent carina, and into species with a simply bowed carina. The species with a carina having a portion projecting freely much resemble species of the genus *Pollicipes*, Leach, and perhaps must be considered as forming

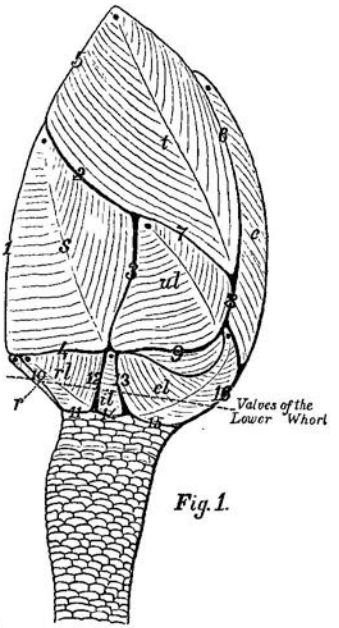

Fig. 1.

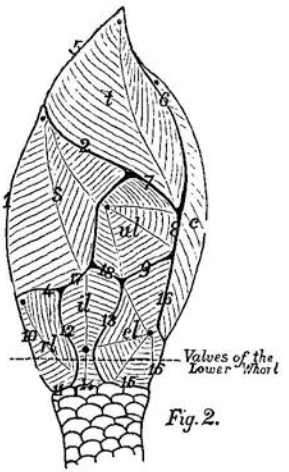

Fig. 2.

In both figures a point indicates the place in each valve where the umbo is situated. *s*, scutum; *t*, tergum; *c*, carina; *ul*, upper latus; *rl*, rostral latus; *il*, infra median latus; *cl*, carinal latus; 1, occludent margin of the scutum; 2, tergal do.; 3, lateral do.; 4, basal do.; 5, occludent margin of the tergum; 6, carinal do.; 2, scutal do.; 6, 8, tergal margin of the carina; 3, scutal margin of the upper latus; 7, tergal do.; 8, carinal do.; 9, basal do.; 10, rostral margin of the rostral latus; 11, basal do.; 12, lateral do.; 4, scutal do.; 12, rostral margin of the infra-median latus; 13, carinal do.; 14, basal do.; 13, lateral margin of the carinal latus; 15, basal do.; 16, carinal do.; 9, upper do.; In fig. 1—*r*, rostrum. In fig. 2 17, scutal margin of the infra-median latus; 18, upper do.

a link between the two genera. Only two species belong to this division. Eight species have an angularly bent carina, so that by far the greatest number (thirty-seven) belong to that division which contains the species with a bowed carina. Only in one of the living species is a sub-carina present. Of the remaining thirty-six, twenty-one have a rostrum and fifteen have no rostrum. Four of those with a rostrum have the rostrum

not covered laterally by the free edges of the rostral latera, seventeen have the rostrum laterally covered.

For the right understanding of the nomenclature used for the valves and their margins in the genus *Scalpellum* the woodcuts figs. 1 and 2 will prove useful.

Fig. 1 represents a *Scalpellum with* a rostrum, and therefore with fourteen valves. Fig. 2 one *without* a rostrum, having therefore only thirteen valves. (A species with a subcarina is figured on Pl. III. fig. 19.) In most valves the umbo is situated at the same place in both figures. The exceptions to this rule are the upper-latus, infra-median latus, and carinal latus. The upper latus, as a rule, has the umbo at the apex, as in fig. 1. In *Scalpellum distinctum*, n. sp. and *Scalpellum planum*, n. sp. however, it is nearly in the middle of the scutal margin. The infra-median latus, ordinarily, is triangular, and in that case it has the umbo at the apex. Sometimes, however, its shape is that of an hour-glass or of an elongate wine-glass on its stand, and then the umbo is seated near or under the middle of the valve. Very interesting are the differences which the carinal latus shows in the different species. There are two types which are represented in the two figures 1 and 2. In fig. 1 the valves of the lower whorl (the rostrum—when there is one—the rostral latus, the infra-median latus, and the carinal latus) are not very much developed in the direction of the long axis of the capitulum. On the contrary, the same valves are much higher or more elongate in the other type (fig. 2). This influences the shape of these valves, but specially that of the carinal latus. In the one (fig. 1 : type, *Scalpellum maximum*, Darwin) the umbo is placed at the apex, as closely as possible to the upper latus. In this case the whole of the carinal margin of this valve extends beneath the umbo. In the other case (fig. 2 : type, *Scalpellum vulgare*, Leach) the umbo is placed at a somewhat considerable distance from the apex, and then either at the base of the carinal margin or about the middle of that margin.

These two forms of the carinal latus were known to Darwin. It is curious enough that all the recent forms known to Darwin have the carinal latus of the shape of fig. 2, and all the fossil forms in which he was able to describe this valve—with the exception of one—show the type of fig. 1. However, this latter type is also represented in the living forms; a considerable number of the species inhabiting the deep-sea and dredged by the Challenger give proof of it. There are in all thirteen species corresponding with the fossil *Scalpellum maximum* with regard to the form of the carinal latus, and nine of these inhabit a depth greater than 500 fathoms. On the other hand, we must not lose sight of the fact that of the remaining twenty-nine species only three were taken at a depth less than 500 fathoms; that the other type, therefore, is represented by twenty-six species in the deep-sea! In the case of the present genus we find, therefore, that the abyssal fauna consists partly of species resembling fossil forms, and for a much more considerable part of species of a true shallow-water type.

Nor does the study of the form of the carina give a more decided result. Darwin

was only acquainted with one recent species of *Scalpellum* (*Scalpellum rutilum*, Darwin), with a simply bowed carina, the umbo of which was placed at the apex. The greater part of his living species had the carina angularly bent. Of the fossil species, on the contrary, he mentions only one (*Scalpellum magnum* (Wood), Darwin), with an angularly bent carina; all the others have the valve simply bowed. Now, as a rule, the carina of the deep-sea species is simply bowed, as is the case with the fossil species. But it is not a rule without an exception, as *Scalpellum stroemii*, Sars, and *Scalpellum carinatum*, n. sp., have the carina rather more angularly bent.

As one of the more interesting forms of Cirripedia dredged during the cruise of the Challenger, I may mention here *Scalpellum trispinosum*, n. sp., which is nearly related to *Scalpellum villosum*, Leach, sp. Like the latter it is highly characteristic, being an intermediate form between *Scalpellum* and *Pollicipes*. It was collected in the Malay Archipelago, at a depth of about 100 fathoms.

The study of the complemental males of some of the species of *Scalpellum* has given very interesting results. Since a more detailed treatment of the organisation of these little creatures will not be given in the present report a preliminary description is inserted under the heading of the different species.

The following table may be of use for the determination of the species:—

Scalpellum.

A. Valves imperfectly calcified.
- A. Valves of the lower whorl imperfectly calcified as well as the other valves, — *Scalpellum marginatum*, n. sp.
- B. Valves of the lower whorl perfectly calcified.
  - a. Calcified portion of the upper latus elongate.
    - (a) Apex of the tergum curved towards the carina, . . — *Scalpellum japonicum*, n. sp.
    - (b) Apex of the tergum straight, ... — *Scalpellum insigne*, n. sp.
  - b. Calcified portion of the upper latus not elongate.
    - (a) Calcified portion distinctly V-shaped, . . . — *Scalpellum ovatum*, n. sp.
    - (b) Calcified portion only slightly concave, . . . — *Scalpellum intermedium*, n. sp.

B. Valves perfectly calcified.
- A. Species with a carina a portion of which projects freely.
  - a. With a sub-rostrum and sub-carina, ... — *Scalpellum villosum*, Leach, sp.
  - b. With a sub-carina only, ... — *Scalpellum trispinosum*, n. sp.
- B. Species with the carina angularly bent.
  - a. With a distinct rostrum.
    - (a) With a sub-carina.
      - α. Three pairs of lower latera, ... — *Scalpellum rostratum*, Darwin.
      - β. Two pairs of lower latera, ... — *Scalpellum peronii*, Gray, sp.
    - (b) Without a sub-carina.
      - α. Umbo of the carina at a considerable distance from the apex.

i. Upper latus quadrant-shaped, with the arched side deeply notched, ... *Scalpellum ornatum*, Gray, sp.
ii. Upper latus irregularly oval, . . . *Scalpellum vulgare*, Leach.
β. Umbo of the carina at a small distance from the apex.
i. Infra-median latus large, oblong-quadrangular, . *Scalpellum stroemii*, Sars.
ii. Infra-median latus large, wine-glass-shaped, . *Scalpellum carinatum*, n. sp.
iii. Infra-median latus small, triangular, . . *Scalpellum recurvirostrum*, n. sp.
B. Rostrum wanting or not distinct, ... *Scalpellum compressum*, n. sp.
C. Species with the carina simply bowed.
A. With a sub-carina, ... *Scalpellum acutum*, n. sp.
B. Without a sub-carina.
(A) Rostrum present.
α. Rostrum not covered laterally by the free edges of the rostral latera.
i. Rostrum wedge-shaped. Carina short, . . *Scalpellum brevecarinatum*, n. sp.
ii. Rostrum elongate, narrow. Carina long, . . *Scalpellum angustum*, G. O. Sars.
iii. Rostrum wine-glass-shaped. Carina long, . *Scalpellum parallelogramma*, n. sp.
iv. Rostrum protuberant, hook-shaped. Carina long, *Scalpellum hamatum*, G. O. Sars.
β. Rostrum covered laterally by the free edges of the rostral latera.
i. Rostrum large oval.
(i) Valves separated by distinct chitinous intervals, ... *Scalpellum album*, n. sp.
(ii) Valves not separated by chitinous intervals, . *Scalpellum africanum*, n. sp.
ii. Rostrum small, distinctly visible at the surface.
(i) Surface of the valves with long hairs, . *Scalpellum hirsutum*, n. sp.
(ii) Surface of the valves smooth, or with short hairs.
1. Infra-median latus quadrangular, . *Scalpellum nymphocola*, n. sp.
2. Infra-median latus triangular, . . *Scalpellum rubrum*, n. sp.
3. Infra-median latus elongate, narrow, . *Scalpellum cornutum*, G. O. Sars.
4. Infra-median latus very small, . . *Scalpellum striolatum*, G. O. Sars.
iii. Rostrum extremely narrow, hardly visible at the surface.
(i) Tergum bluntly truncated, . . . *Scalpellum truncatum*, n. sp.
(ii) Tergum triangular, not truncated, . . *Scalpellum elongatum*, n. sp.
iv. Rostrum only visible after the chitinous membrane has been taken away.
(i) Umbo of the carinal latus almost at the base of the valve, ... *Scalpellum antarcticum*, n. sp
(ii) Umbo of the carinal latus at a distance from the base.
1. Roof of the carina flat.

(1) Umbo of the carinal latus much projecting beyond the line of the carina.
a. Upper latus triangular, . . *Scalpellum velutinum*, n. sp.
b. Upper latus quadrangular, . *Scalpellum pedunculatum*, n. sp.
(2) Umbo of the carinal latus not much projecting, . . . *Scalpellum eximium*, n. sp.
2. Roof of the carina slightly convex laterally.
(1) Carinal latus very high, . . *Scalpellum gigas*, n. sp.
(2) Carinal latus not very high.
a. Upper latus almost triangular, . *Scalpellum moluccanum*, n. sp.
b. Upper latus rather quadrangular.
(*a*) Peduncle short, . . *Scalpellum regium* (Wyv. Thoms.), n. sp.
(*b*) Peduncle long, . . *Scalpellum darwinii*, n. sp.

(B) Rostrum wanting.
a. Carina consisting of a roof and distinct sides.
i. Roof flat, bordered by more or less prominent ridges.
(*a*) Infra-median latus large, wine-glass-shaped, . *Scalpellum distinctum*, n. sp.
(*β*) Infra-median latus middle-sized, oblong-quadrangular.
(i) Carina almost straight, . . . *Scalpellum minutum*, n. sp.
(ii) Carina strongly bowed, . . . *Scalpellum abyssicola*, n. sp.
(*γ*) Infra-median latus small, triangular, . . *Scalpellum vitreum*, n. sp.
(*δ*) Infra-median latus narrow, elongate.
(i) Scutum almost triangular, . . *Scalpellum planum*, n. sp.
(ii) Scutum quadrangular.
1. Umbo of the carinal latus projecting beyond the carina, . . *Scalpellum australicum*, n. sp.
2. Umbo of the carinal latus not projecting beyond the carina, . *Scalpellum tenue*, n. sp.
(*ε*) Infra-median latus large, quadrilateral, . . *Scalpellum rutilum*, Darwin.
ii. Roof flat, not bordered by distinct ridges.
(*a*) Carina very strongly bowed, . . . *Scalpellum indicum*, n. sp.
(*β*) Carina not very strongly bowed.
(i) Infra-median latus small, triangular, . *Scalpellum tritonis*, n. sp.
(ii) Infra-median latus elongate, quadrangular, *Scalpellum novæ-zelandiæ*, n. sp.
iii. Roof slightly convex laterally.
(*a*) Infra-median latus triangular, . . . *Scalpellum dubium*, n. sp.
(*β*) Infra-median latus narrow, . . . *Scalpellum flavum*, n. sp.
(*β*) No distinct roof can be distinguished on the carina.
i. Carinal latus as high as the carina, . . *Scalpellum balanoides*, n. sp.
ii. Carinal latus of the ordinary height, . . *Scalpellum triangulare*, n. sp.

A. SPECIES WITH IMPERFECTLY CALCIFIED VALVES.

Scalpellum marginatum, n. sp. (Pl. VI. figs. 5, 6).

Valves thirteen, imperfectly calcified, covered by a chitinous membrane. Carina simply bowed, with the umbo almost at the apex. Upper latus has the form of a V, the umbo being placed at the angle of the two segments.

This species belongs to the same division of the genus as *Scalpellum japonicum* and *Scalpellum insigne*, the most characteristic feature of which consists in the valves being imperfectly calcified. The present species is represented by a single specimen only.

The *capitulum* has a nearly oval shape, and is rather flat. It consists of thirteen valves, each of which is imperfectly calcified, and most of which consist of two segments united at the place where the umbo is seated. The valves are clothed by membrane which is covered with extremely minute and short spines.

The *scutum* consists of an occludent and a tergal segment. The latter is narrow, the former is of considerable breadth near the base, growing much narrower towards the upper extremity. The basal margin forms an acute angle with the occludent margin, and is hollowed out for the reception of the scutal margin of the rostral latus. The apex is slightly recurved, the tergal margin slightly hollowed out.

The *tergum* is triangular, and consists, its calcified part at least, of two segments of about the same width and united at the apex, which is distinctly recurved. Occludent margin arched. Carinal segment very long, reaching farther down than half the length of the carina.

Carina simply bowed, the flat roof is bordered on each side by a ridge. The umbo is at a very short distance from the apex of the carina; the part in front of it is a continuation of the sides of the valve. These are not very broad, and have the same breadth over almost the whole length of the carina. Between the carinal margin of the tergum and the side of the carina there is a rather broad oval interspace filled out with chitinous membrane.

Upper latus consisting of two segments which meet one another in the apex. This penetrates into the cavity which was left between the two segments of the scutum. From the umbo, which is seated at the apex, a third calcified segment starts, which, however, is only small, and has a direction perpendicular to the carinal segment of the tergum.

Rostral latus of irregular shape; a narrow segment runs along the basal margin of the scutum and penetrates into the hollow of this margin. A short and stout segment runs close to the upper margin of the peduncle.

Infra-median latus with the umbo near the base. A small triangular part beneath the umbo and a larger triangular part above it. The latter is hollowed out at the upper margin for the reception of the scutal segment of the upper latus. This triangular part is furnished on both sides with a rather prominent ridge.

Carinal latus has also the shape of a V. The umbo is at the base, and at the foot of the carina; it is slightly protuberant beyond the carina, and is acutely pointed. The carinal segment of the valve is rather long, the basal segment a little shorter.

Length of the capitulum, 22·5 mm.

The *peduncle* is short, cylindrical (5 mm.). There are seven rows of scales, each con-

taining about six scales. The scales are covered by membrane, their free edges are broad and rather prominent.

This species was taken north of New Guinea, at Station 216, February 16, 1875; lat. 2° 56′ N., long. 134° 11′ E.; depth, 2000 fathoms; bottom temperature, 0°·9 C.; bottom, Globigerina ooze.

Observations.—As only a single specimen of this species was taken, I was unable to study the structure of the animal more in detail. I tried in vain to find a complemental male at the place ordinarily occupied by them in the species of this genus.

Scalpellum japonicum, n. sp. (Pl. III. figs. 9, 10).

Valves fourteen, calcified only in part, those of the lower whorl perfectly calcified, all covered by a chitinous and villous membrane. Carina with a flat roof, latera of the carina distinctly developed in the uppermost part; umbo of the carina at $\frac{1}{12}$th of the length of the flat roof from the apex. Upper latus of an irregular long oval shape. Peduncle short.

Only one specimen of this species has been collected. In many respects it agrees with *Scalpellum carinatum*, but it may be distinguished at first sight from that species by the valves being incompletely calcified.

Capitulum rather elongated, compressed, the basal part being only slightly thicker. The calcareous parts of the different valves are separated from each other by rather broad chitinous interspaces. Valves incompletely calcified. As far as the valves are concerned, this species stands about in the same relation to the other species of *Scalpellum* as the species of *Dichelaspis* to those of *Lepas*. However, I do not believe that in the present case there can be any question of proposing a generic separation.

Scutum long and narrow, with the umbo at the apex; divided into two segments; the occludent one being large and increasing in width from the upper to the lower part, the other (the tergal one) being very narrow. Occludent margin slightly arched.

Tergum divided into an occludent and a carinal segment, between which there is a triangular chitinous portion. Umbo at the apex, which is distinctly recurved. Occludent margin arched.

Carina with a flat roof much increasing in width from the apex towards the base. The roof is bordered by slightly prominent ridges. Sides of the carina at right angles with the roof, very narrow at the base, broader near the apex, where the two sides meet in front of the umbo. The umbo is situated at about one twelfth of the length of the flat roof from the upper extremity of the valve.

Upper latus of an irregularly oval shape, with the umbo at a short distance from the upper extremity. All round, the upper latus is separated by chitinous interspaces from the other valves. Calcified portion of an elongate shape.

Rostrum extremely small and narrow, hardly visible even with a lens; covered by chitinous membrane.

Rostral latus short, rather broad, convex. Scutal margin straight.

Infra-median latus hour-glass-shaped, with the umbo at the constricted part. The part above the umbo is triangular and large, that beneath it is also indistinctly triangular but very small.

Carinal latus has much the same shape as in *Scalpellum vulgare;* flat, with the umbo at the base of the carina, where the two carinal latera of the right and left side almost touch each other. The carinal margin is divided into two parts, a superior one which is hollowed out, and a very short and slightly protuberant inferior one. The basal margin is short, the lateral margin arched.

Length of the capitulum, 13·5 mm.

The *peduncle* is short (4·5 mm.), curved, with the scales large and not numerous. There are about eight longitudinal rows, each of which contain about seven scales.

The only specimen of this species was found attached to the shell of an Opisthobranchiate Gasteropod (*Rissoa*, sp. ?), and was collected at Station 235, June 4, 1875; lat. 34° 7′ N., long. 138° 0′ E.; depth, 565 fathoms; bottom temperature, 3°·3 C.; bottom, mud.

Observations.—I failed to observe the complemental male of this species. I have not been able to study the parts of its mouth and its cirri, as I was not at liberty to dissect the only specimen which was collected.

Scalpellum insigne, n. sp. (Pl. VI. figs. 3, 4).

Valves thirteen, imperfectly calcified, except those of the lower whorl which are perfectly calcified, covered by membrane which is clothed with spines. Carina with a flat roof and the umbo seated at or close to the apex. Calcified portion of the upper latus semi-lunar in shape. Peduncle short.

This species is represented by a single specimen only; in many respects it comes near to *Scalpellum japonicum*.

Capitulum consisting of thirteen valves, clothed by a thin chitinous membrane covered with numerous very small hairs. The form of the capitulum is elongate-oval. Extremely characteristic is the imperfect calcification of the valves, and especially of the tergum, scutum, and upper latus. These are separated from each other and from the carina by broad chitinous interspaces.

Scutum elongate, almost triangular. Its greatest breadth is near the inferior extremity; its length is only twice this breadth. The umbo is at the apex, which projects over the tergum. The occludent margin is slightly arched. Of the two triangular parts into which the scutum in other species of the genus is divided by a ridge, only one (the occludent one) is calcified, the other is only represented by membrane.

Tergum triangular, with the margins almost straight. The calcified part has the form of a fork, and consists of two segments,—an occludent and a carinal segment of nearly equal width, the point of junction being the apex of the valve.

Carina simply bowed, with a flat roof and well-developed sides, tapering towards the lower extremity. The roof does not increase much in width from the upper to the lower end.

Upper latus of a quadrangular form; the calcified part is semi-lunar, with the umbo at a short distance from the apex; the valve, therefore, is also a little added to upwards.

Rostral latus quadrangular, middle-sized; lateral margin arched.

Infra-median latus triangular, small; umbo at the apex. Rostral and carinal margins hollowed out.

Carinal latus almost triangular, with the umbo near the base, slightly projecting outwards beyond the carina. Carinal margin hollowed out, lateral margin short and rounded.

Length of the capitulum, 16 mm.

Peduncle cylindrical, slightly bowed. Length of the peduncle, about 5 mm. Covered by membrane; the free edges of the scales are only indistinctly visible. There are seven or eight longitudinal rows of scales, each row containing ten or more scales.

This species was taken in the Atlantic at Station VI., January 30, 1873; lat. 36° 23′ N., long. 11° 18′ W.; depth, 1525 fathoms; bottom temperature, 1°·6 C.; bottom, Globigerina ooze.

Observations.—The complemental male of this species is not known, nor could I investigate the structure of the parts of its mouth, cirri, &c.

Scalpellum ovatum, n. sp. (Pl. VI. figs. 7, 8).

Valves thirteen, covered by chitinous membrane, without distinct spines. Tergum and upper latus imperfectly calcified, the calcified portion of the latter being V-shaped. Umbo of the carina close to the apex. Carina with a flat roof, not much increasing in width from the upper to the lower extremity.

Of this species a single specimen was taken at Station 216, at which *Scalpellum marginatum*, n. sp., was also taken. I was a long time in doubt whether it represents a different species, or must be considered as a variety of *Scalpellum marginatum*. I even felt inclined to consider it as an intermediate form between *Scalpellum marginatum* and *Scalpellum compressum*. After much hesitation, however, I decided on describing it as a distinct species.

The *capitulum* is rather flat, though not so much so as in *Scalpellum compressum*, and elongate, being about twice as long as broad. The greatest breadth is a little beneath the umbo of the scutum. The capitulum consists of thirteen valves, the borders of which are not everywhere distinguishable, the chitinous membrane covering the valves being rather thick.

The *scutum* is not very large, of an irregular quadrangular shape. The apex, where the umbo is situated, is produced, the tergal margin hollowed out, the occludent margin convex, the basal margin oblique, with an excavation for the reception of the rostral latus.

The *tergum* is large, surpassing the scutum considerably in area. Its occludent

margin is arched, its apex recurved. The scutal margin is convex and the carinal margin quite indistinct, the valve not being separated by a distinct margin from the side of the carina. The calcified part is V-shaped, and consists of two segments, one at the occludent, and one at the carinal margin of the valve. The latter is a great deal longer and a little broader than the former.

The *carina* has a narrow flat roof, not increasing much in width towards the base, where the roof is slightly furrowed longitudinally. The sides are at angles greater than 90° with the roof. They are not flat but slightly convex, and wider near the upper extremity. They are only indistinctly limited near the tergum and near the upper latus.

The *upper latus* is quadrangular, with the basal-carinal angle truncated; hence the valve is pentagonal. The valve is imperfectly calcified, and consists of two segments uniting at the scutal-tergal angle. The apex is slightly produced over the scutum.

The *rostral latus* is pentagonal, the umbo is seated at the rostral extremity beneath the occludent margin of the scutum. The valve is medium-sized.

The *infra-median latus* is elongate quadrangular; its umbo is situated near the base.

The *carinal latus* is of an irregular shape. A triangular part of it penetrates between the carina and the upper latus. The umbo is near the base, and projects slightly over the base of the carina. The basal margin is straight, the carinal margin hollowed out.

Length of the capitulum, 20 mm.

The peduncle is cylindrical, and almost imperceptibly slopes into the capitulum. The scales are large, and not calcified, or, perhaps, are totally covered by membrane. The edges are not very prominent and their number is insignificant.

This species was taken with *Scalpellum marginatum* at Station 216, February 16, 1875; lat. 2° 56′ N., long. 134° 11′ E.; depth, 2000 fathoms; bottom temperature, 0°·9 C.; bottom, Globigerina ooze.

Observations.—I could not find a complemental male at the place ordinarily inhabited by it. As I had only a single specimen at my disposal, the study of the parts of its mouth and of its cirri has not been undertaken. Still, this would be the only way to ascertain whether or not there exists a specific difference between this species and *Scalpellum marginatum*.

Scalpellum intermedium, n. sp. (Pl. VI. fig. 13; Pl. VIII. figs. 6–8).

Valves thirteen, imperfectly calcified, except those of the lower whorl, all covered by chitinous membrane. Carina with the umbo at the apex and a flat roof bordered on each side by a distinct ridge. Calcified portion of the upper latus only slightly hollowed out and nearly triangular. Peduncle short.

This species was dredged on two occasions. Once two specimens were taken, the other time only one. The tergum is distinctly V-shaped; the upper latus, on the contrary, is only slightly hollowed out at the basal margin.

The *capitulum* is flat and elongate; it is covered by a very thin chitinous membrane, which is only slightly hairy. The number of the valves is thirteen; on close examination, however, a rudimentary rostrum, close to the lower extremity of the occludent margin of the scutum, makes its appearance.

Scutum elongate, twice and a half as long as broad. The occludent margin is distinctly arched, the basal margin almost straight; the lateral margin describes an elegant curve, being arched in the lower half and hollowed out in the upper half. The tergal margin is also slightly hollowed out. The umbo of the valve is at the apex, which is slightly recurved, and projects a little over the tergum.

Tergum triangular; the calcified part consists of an occludent and of a carinal portion. The scutal margin is distinctly hollowed out by a triangular chitinous portion. The sides are nearly straight.

Carina robust, simply bowed, with the umbo at the apex; consisting of a flat roof bordered on each side by a distinct ridge and well developed lateral parts. The latter increase in width from the lower to the upper extremity.

Upper latus nearly triangular or trapeziform, owing to the presence of a very short carinal margin. The umbo is at a short distance from the apex, hence the growth is slightly upwards also. Basal margin slightly excavated about the middle.

(*Rostrum* rudimentary, represented by an extremely small triangular portion.)

Rostral latus convex, quadrangular-trapeziform, the scutal margin being a great deal longer than the basal margin.

Infra-median latus small, triangular. The umbo is seated at the apex.

Carinal latus nearly quadrangular, with the lateral margin parallel to the carinal margin; the latter, however, is a great deal longer, and forms with the upper margin a triangular portion penetrating between the carina and the upper latus. The umbo of the valve is seated at or near the base, and is distinctly protuberant beyond the base of the carina. The basal margin is nearly straight.

Length of the capitulum of the largest specimen, 9 mm.

The *peduncle* is short, measuring in the 9 mm. specimen not quite 2 mm. It is covered by well-developed scales, eight of which are placed in a longitudinal row, seven longitudinal rows composing the armature of the peduncle.

During the cruise of the Challenger, this species was taken at Station 164A, June 13, 1874; lat. 34° 13′ S., long. 151° 38′ E.; depth, 410 fathoms; bottom temperature, ?; bottom, grey ooze. One specimen. Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 4°·2 C.; bottom, grey ooze. Two specimens.

Observations.—On investigating the internal surface of the scuta of one of the specimens, I found that both valves were furnished with a complemental male. Like the animal within the capitulum, they were not well preserved, and therefore I will not enter into

details as to their internal structure. The male (Pl. VIII. fig. 8) has an elongate oval shape, the surface is irregularly folded; its length was about 0·75 mm.; it was covered by a thin chitinous mantle bearing very short hairs over its whole surface. At one extremity, which no doubt corresponds to the extremity of the peduncle, a couple of small knobs were seen, which probably served for the attachment to the interior surface of the scutum. At the other extremity rudiments of valves were visible. I could make out four of them, and they had a very regular oval shape. Between these rudimentary valves there is probably an opening present; a tuft of hair-like cirri protrudes from this opening, and may be traced for some distance within the cavity of the mantle.

Of the female and hermaphrodite animal I have figured the mandible and the maxilla. The mandible (Pl. VIII. fig. 6) has three teeth, the first of which is slightly longer than the two others; the inferior angle is a little produced and elegantly pectinated. The maxilla (fig. 7) has the free edge almost straight; two large spines are implanted near the upper extremity, and another large spine is visible at a little distance from the lower end. The remaining spines are small, and placed at some distance from one another.

B. SPECIES WITH PERFECTLY CALCIFIED VALVES.

A. Species with a carina, a portion of which projects freely.

Scalpellum trispinosum, n. sp. (Pl. VI. figs. 15, 16).

Valves thirteen; surface of the valves covered by membrane. Carina simply bowed; umbo at the apex, the part of the carina where the apex is placed projects freely. Rostrum and sub-carina present, sub-rostrum wanting. Upper latus triangular, small; latera of the lower whorl two, small, triangular.

This curious species is represented by a single adult specimen only. Two extremely small specimens of the same species are inserted near its base.

The *capitulum* in general shape resembles that of *Scalpellum villosum*, Darwin. It consists of thirteen valves—the sub-rostrum of *Scalpellum villosum* is not represented in *Scalpellum trispinosum*. All the valves are covered by a villous membrane; the umbones near the apex are the only naked parts. The scuta, terga, and the carina are relatively large; the upper latera and the valves of the lower whorl are small, and placed a little apart from each other. As in *Scalpellum villosum*, all the valves are added to at their inferior ends.

The *scutum* is large, triangular. The apex projects distinctly outwards; the occludent margin is slightly hollowed out; the basal margin is elongated.

The *tergum* is large, flat, triangular, in area much surpassing the scutum. The occludent margin is straight, the scutal margin convex, the carinal margin convex also.

The *carina* is boat-shaped and without a flat roof. The umbo is at the apex, which

projects freely for some distance. The sides of the carina are distinctly developed in the superior part, tapering towards the inferior extremity.

The *rostrum* is short, triangular, with the apex recurved towards the opening slit between the two scuta.

The *upper latus* is triangular, and situated almost between the rostral and carinal latera. Of these valves, and also of the rostrum and the sub-carina, the umbonal parts only can be clearly distinguished, the basal parts being totally embedded in the membrane.

The *carinal latus* is a little smaller than the upper latus; the *rostral latus* is a little smaller than the carinal latus.

Finally, the *sub-carina* almost equals in area the rostrum. Its apex, however, is not so distinctly recurved as is the case in the rostrum.

Length of the capitulum 13 mm., breadth in the middle 8 mm.

The *peduncle* is very robust, its width almost equalling that of the capitulum. It has a length of 6 mm. and is cylindrical, being only slightly compressed laterally. Its extremely small scales are totally covered by membrane, so that not even their summits are visible. The hairs clothing the membrane are very short, and can only be distinguished by means of a magnifying lens.

This interesting species was taken at Station 201, October 26, 1874; lat. 7° 3′ N., long. 121° 48′ E.; depth, 82 and 102 fathoms; bottom, stones and gravel.

Observations.—Station 201 is situated in the Philippine Archipelago, and probably *Scalpellum villosum*, Leach, sp., with which this species is nearly related, is also an inhabitant of the Malay Archipelago. Both species come very near to *Pollicipes*. The small number of the valves and the presence of complemental males made Darwin place *Scalpellum villosum* by the side of the other species of *Scalpellum*. Whereas in the first mentioned point *Scalpellum trispinosum* even surpasses *Scalpellum villosum* (a sub-rostrum which is present in *Scalpellum villosum* is wanting in *Scalpellum trispinosum*), I was unable to ascertain the presence of a complemental male.

B. Species with the carina angularly bent.

Scalpellum stroemii, Sars (Pl. III. fig. 6; Pl. VII. figs. 12–14; Pl. VIII. figs. 1–5).

Scalpellum stroemii, Sars, Forhandl. Vidensk. Selsk. Christiania (1858), 1859, p. 158.
„ „ Sars, Verrill, Amer. Journ. Sci. and Arts, ser. 3, vol. vii., 1874, pl. viii. fig. 7.

Valves fourteen, not covered by membrane. Carina distinctly bent, with the umbo at a small distance from the apex; upper latus pentagonal; valves of the lower whorl much developed. Infra-median latus oblong-quadrangular.

In the collections made during the cruise of the Challenger this species is represented by nineteen specimens. Moreover, Mr. Murray sent me two specimens dredged in the summer of 1882 by H.M.S. "Triton." The description of this species given

by Prof. M. Sars, though not very complete, is sufficient for its recognition. In general appearance it much resembles *Scalpellum vulgare*, but it may be distinguished at first sight by the smoothness of its valves.

The *capitulum* is robust, quadrangular; at the base it is a great deal thicker than near the upper extremity, in the middle of the lower whorl its thickness is increased still more by a gibbous lateral excrescence.

The *scutum* is rather small, slightly longer than broad; its apex distinctly projects over the tergum.

The *tergum* is large, triangular, with the occludent margin convex and the apex recurved. The carinal margin is almost straight, the scutal margin also.

The *carina* is boat-shaped, with the umbo at one-fifth of the length of the valve from the apex. The sides are well-developed, the roof in the lower part is almost flat.

The *upper latus* is of a pentagonal shape, the tergal and scutal margins being nearly equal, as also the three other margins.

The *rostrum* is well-developed, cuneiform, narrow at the apex, which projects over the edge of the scutum, and considerably increasing in width towards the base.

The *rostral latus* is trapeziform, the basal and scutal margins being parallel to each other, the first, however, being much shorter than the second.

The *infra-median latus* is quadrangular, its height slightly surpasses its width.

The *carinal latus* has about the same area as the infra-median latus. The basal margin is straight, the carinal margin slightly hollowed out in its superior, and convex in its inferior portion. The lateral margin is also slightly hollowed out. The umbo projects over the hind margin of the capitulum; the umbones of the two carinal latera almost touch each other under the middle of the carina.

Length of the capitulum of the largest specimen 9·75 mm., breadth 5·5 mm.

The *peduncle* is short (3 mm.), cylindrical; eight calcareous scales form together a longitudinal row, of which there are about nine.

Mouth.—Labrum with the upper part highly bullate (Pl. VII. fig. 12) and the palpi elongate and very narrow, especially at the extremity, where they are furnished with some large bristles. *Mandibles* (fig. 13) with three teeth, equidistant from one another; the third tooth is sharply pointed. The lower edge of the mandible is broad and truncated, both edges of the truncated part bearing three small teeth. *Maxillæ* (fig. 14) rather narrow, with the spinose edge straight; all the spines are of about the same size, with the exception of the two uppermost ones, which are slightly greater. *Outer maxillæ* (Pl. VIII. fig. 5) rounded; the inner margin is sparingly hairy, the summit very hairy. The (so-called) olfactory orifices are placed at the extremity of a tubular process.

Of the *cirri* I wish to point out only that the first pair (Pl. VII. fig. 12) has very

unequal rami; the most anterior one is shorter and a great deal thicker than the posterior one. The former has five, the latter six segments.

This species was taken at Station 49, May 20, 1873; lat. 43° 3′ N., long. 63° 39′ W.; depth, 83 fathoms; bottom temperature, 1°·8 C.; bottom, gravel, stones. Numerous specimens. Station 10, cruise of H.M.S. "Triton;" August 24, 1882; lat. 59° 40′ N., long. 7° 21′ W.; depth, 516 fathoms. Bottom, mud; bottom temperature, 8° C. Two specimens.

Observations.—This species seems to be common throughout the northern part of the Atlantic Ocean. A very interesting observation was made in one of the specimens dredged in August 1882 by H.M.S. "Triton." On opening it, I found it contained eggs. They were large and not extremely numerous. On studying them with the microscope I found they had passed already the Nauplius-stage, and had arrived at the Cypris-stage. The exuviæ of the Nauplius-larva still adhered to the covering of the Cypris, though it was not easy to make out which parts had developed from the Nauplius-appendages. I figure an egg in the Cypris-stage in fig. 1 of Pl. VIII. The first pair of Nauplius-appendages changed into the antennæ of the Cypris, but of the two other pairs only one was visible. Whether its basal part has changed into one of the excrescences which fill up the interspace between the antennæ and the cirri, I cannot say with certainty. Of the cirri there are six pairs, behind which a rudimentary cirrus is still observed. They almost seem to have developed within that part of the Nauplius-larva which, as a distinct excrescence, is attached to the ventral side.

When complemental males are present there is one attached to the interior side of the scutum. Pl. VIII. fig. 4 shows the place it occupies (*a*). The chitinous membrane covering the valve on its interior surface forms a little pouch, the opening of which is directed towards the occludent margin of the valve. In this pouch the male is lodged. I got two rather different specimens of this male, and as I think our knowledge is still very insufficient in this respect, I give figures of both specimens. Probably the male figured in fig. 2 (Pl. VIII.) has not yet quite passed through its metamorphosis. At the one extremity it is furnished with the two small prehensile antennæ (*an.*), and at the other extremity a kind of disc is observed with an opening in it. The body is very flat. Muscles are seen running towards the antennæ, and probably the testis and the genital duct are represented. In the other stage (fig. 3) the animal has grown more robust; the body is no longer flat, but the size has slightly diminished: in the stage of fig. 2 the size is 0·8 mm., in that of fig. 3 only 0·6 mm. The disc-like appendage has disappeared, and the two prehensile antennæ are now represented by a single stout excrescence. As in the first stage, the chitinous membrane which covers the body is rather thick; it is, however, no longer so distinctly striated as was the case in the first stage. The internal viscera are much better to be distinguished; they are only represented by the genital apparatus. This consists of a glandular mass, the testis (*t.*) and a duct, which is much

swollen, and probably functions as a receptaculum seminis (*r.s.*). I think I have observed an opening near *o.*, but I do not feel quite sure.

Scalpellum carinatum, n. sp. (Pl. III. figs. 7, 8).

Valves fourteen; surface smooth; valves separated by broad chitinous interspaces. Carina bowed, with a flat roof, the apex of which, however, is not the apex of the valve which, therefore, is angularly bent. Upper latus of an irregular pentagonal shape. Infra-median latus large and wine-glass-shaped.

This species has about the same shape of carina as *Scalpellum japonicum* and *Scalpellum recurvirostrum*. This form stands between the carina with a perfectly flat roof (*e.g.*, *Scalpellum robustum*), and those with a distinct angularly bent carina (*e.g.*, *Scalpellum vulgare*). The species is represented by two specimens, only one of which, however, is full-grown.

The *capitulum* consists of fourteen valves, and is covered by a very thin, transparent chitinous membrane. The valves are separated by distinct interspaces of membrane. The capitulum is coloured dirty white, the interspaces have a yellowish-grey colour.

Scutum elongated, twice and a half as long as broad; apex pointed, basal margin oblique, forming a right angle with the occludent margin, but passing with a rounded angle into the lateral margin. This margin is slightly hollowed out, and is separated from the tergal margin by a not very large rectangular projection or shoulder. The occludent margin is very convex, the tergal margin is short and hollowed out. The umbo is at the uppermost point, where the valve shows a distinct triangular and feebly recurved projection.

Tergum large, triangular, flat, with the inferior part produced and the apex much recurved. The scutal margin has a small projection near the occludent margin, and this projection is placed behind the triangular projection at the apex of the scutum. The occludent margin is very much arched, the carinal margin is divided by a small projection near the apex into a small superior and a long inferior part, both parts being concave.

The *carina* in the inferior part is simply bowed, with a flat roof, much increasing in width from the upper to the lower end, and bordered on each side by a not very distinct ridge. The umbo is seated at the top of the flat roof and at a small distance from the apex of the valve. The part above the umbo is formed by the upward prolongation of the sides of the valve, which diminishes in size below, so as to terminate in a long point at the base of the carina.

The *upper latus* is irregularly pentagonal, flat; upper half acuminate, lying between the tergum and the scutum, the lower half broad. The umbo is not at, but near, the apex; the valve therefore is added to not only downwards but also a little round the two sides of the apex. These additions do not take place in the early stages of growth, and therefore, they form a depressed rim.

Scutum, tergum, and upper latus much resemble those of *Scalpellum rutilum*, Darwin.

Rostrum elongated and extremely narrow; quite enclosed between the two rostral sides of the rostral latera.

Rostral latera convex, with the rostral margin shorter than the arched infra-median margin, scutal margin slightly hollowed out, basal margin passing over with a rounded angle into the infra-median margin. Along the scutal margin a distinct ridge is observed, under which the valve is transversely hollowed out; a second ridge runs from the apex to the rounded infra-median margin.

The *infra-median latus* has the form of a wine-glass with a foot. The umbo is seated beneath the middle, hence the growth is for the greater part upwards; the valve is added to also round its rostral and carinal sides.

The *carinal latus* has almost the same shape as in *Scalpellum vulgare;* it is large, flat; the carinal margin is hollowed out, the basal margin passes over indistinctly into the lateral margin. The umbones of the two valves almost touch each other under the middle of the carina, and project over the base of the carina.

Length of the capitulum about 16 mm.; of the peduncle about 6 mm.

The *peduncle* is nearly cylindrical, with not very numerous scales at the surface. These are placed in about seven longitudinal rows, each row containing four to six scales. The scales are distinctly calcareous, hence white, and separated from each other by rather large intervals.

This species was taken at Station 135, near the Island of Tristan da Cunha; October 16–18, 1873; depth, 1000 fathoms; bottom, rock, shells.

Observations.—No complemental male was present in the specimen I investigated in a detailed manner. The relations of this species to the other species of the genus are rather complex. The form of the carina much resembles that of *Scalpellum japonicum*, but it differs from this species by the valves being completely calcified. The roof of the carina is flat as in the following section of the genus, but it has the umbo placed at a distance from the upper extremity of the valve.

Scalpellum recurvirostrum, n. sp. (Pl. III. figs. 11, 12; Pl. VIII. figs. 9, 10).

Capitulum covered by membrane. Valves fourteen, separated by broad membranous interspaces. Umbo of the carina at a little distance from the apex, hence the valve is slightly angularly bent. Upper latus trapeziform. Infra-median latus triangular. Peduncle cylindrical, with the calcareous scales scattered and at a considerable distance from one another.

Three larger and numerous very small and young specimens of this species were taken between Kerguelen and Heard Islands. It is middle-sized, and belongs to the same division of the genus as *Scalpellum vulgare*, Leach.

The *capitulum* is robust, about twice as long as broad, and not very flat. It is covered by a thin membrane, and the different valves are separated by broad chitinous interspaces. A distinct white line divides these interspaces into two equal parts, and marks the area of the different valves. Of these there are fourteen. The lines of growth are not distinct.

The *scutum* is elongate quadrangular; it is somewhat broader near its base than in the upper half. The umbo is at the apex, which slightly projects outwards, and which has a triangular, recurved, and pointed form.

The *tergum* is triangular. The occludent margin is much arched, hence the apex is distinctly recurved. The inferior part is a little produced.

The *carina* is bowed and internally concave; the portion above the umbo is very short, and not more than one-sixth of the total length. Since the roof is slightly convex, the sides of the carina pass over into the portion above the umbo.

The *upper latus* is trapeziform, with the scutal margin slightly hollowed out and not quite twice as long as the carinal margin. The apex is sharply pointed.

The *rostrum* is small, triangular, wedge-shaped.

The *rostral latus* is convex, four-sided, with the scutal and basal margins almost parallel and slightly hollowed out.

The *infra-median latus* is extremely small, triangular, with the umbo at the apex.

The *carinal latus* is flat, four-sided; basal margin nearly straight. Superior portion of the carinal margin slightly hollowed out, inferior portion short, lateral margin straight. The umbo is seated at the base of the carina and projects slightly outwards.

Length of the capitulum 13 mm.

The *peduncle* is cylindrical, and has a length of 7·5 mm. Very small and not numerous calcareous scales are scattered over its surface. At the place of attachment the foot of the peduncle grows wider.

Mouth.—*Mandibles* with three teeth, and the inferior angle pectinated, almost as in *Scalpellum intermedium*. *Maxillæ* (Pl. VIII. fig. 9) with a rather deep notch behind the first four spines, and a second less deep notch in front of the inferior angle. The second maxillæ have the so-called olfactory orifices at the end of long processes.

Cirri.—First pair with very unequal branches; the anterior and shorter branch has six rather broad segments, the posterior eight longer and more slender segments. The outer surface of the segments is extremely hairy. Of the other cirri nothing very characteristic has been observed.

The *caudal appendages* (Pl. VIII. fig. 10) are elongate and distinctly four-jointed; each segment bears two small spines at the extremity; the fourth is crowned by a tuft of about five stouter and two smaller bristles.

Penis short, rudimentary.

Complemental males not observed.

This species was taken at Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms; bottom temperature, 1°·8 C.; bottom, rocks.

Scalpellum compressum, n. sp. (Pl. III. figs. 13, 14).

Capitulum covered by a thick chitinous membrane, hence the limits of the valves can be only with difficulty made out. Valves thirteen, rostrum wanting. Umbo of the carina at a short distance from the apex, the valve therefore angularly bent. Sides of the carina extremely broad. Upper latus pentagonal.

This true deep-sea species is represented by a single specimen only. It is a highly characteristic form, constituting almost a distinct division of the genus by itself.

The *capitulum* is extremely flat, compressed, and consists of thirteen valves. An extremely small rostrum became visible as the thick chitinous membrane at the foot of the occludent margin of the scutum was taken away. I think it hardly advisable to consider it as a fourteenth valve. As the species is represented by a single specimen only, and as I was not permitted to sacrifice it, I have not isolated the different valves, which would have been the only way to ascertain their form. It was especially difficult to make out the valves of the lower whorl.

The *scutum* is not very large; its occludent margin is in length nearly twice the breadth of the valve; the lateral margin is about equal to the breadth of the valve. The scutum is divided into two triangular parts by a very prominent ridge. The umbo is at the apex, which is slightly recurved.

The *tergum* is triangular, with the occludent margin almost straight, and the carinal margin arched. The scutal margin is straight. The valve is divided into two parts by a very prominent ridge, which is itself flat and arched, the hollow side being turned towards the carina.

The *carina* has a narrow roof and broad sides. Near its base the roof is deeply furrowed, but this furrow disappears towards the upper extremity, where the roof is quite flat. That part of the carina which is situated above and in front of the umbo describes an obtuse angle with the roof, and runs almost imperceptibly into the margin of the tergum. The chitinous membrane which covers the carina is longitudinally striped.

The *upper latus* is pentagonal; the umbo is at some distance from the apex.

The *rostral latus* is quadrangular, the scutal margin hollowed out, the basal margin short, the rostral margin slightly arched.

The *infra-median latus* is narrow, its umbo at a short distance from the base. Beneath it there is a small triangular part, above it an elongated part. Perhaps the infra-median latus is much broader, especially towards the carinal latus.

The *carinal latus* is quadrangular, the carinal margin hollowed out. The umbo is seated near the base, and does not extend beyond the carina.

Length of the capitulum, 31 mm.

The *peduncle* is cylindrical, narrow, short (10 mm.); the scales are not calcareous, but yet their margins are very distinct. They form eight longitudinal rows, each containing about eight scales.

A single specimen of this species was taken at Station 198, October 20, 1874; lat. 2° 55′ N., long. 124° 53′ E.; depth, 2150 fathoms; bottom temperature, 3°·7 C.; bottom, red clay.

Observations.—I have not been able to investigate the structure of the mouth, of the cirri, of the caudal appendages, &c. With regard to the complemental males, I found on the interior surface of the right-hand scutum five of them attached close to the occludent margin. I have figured one of them (Pl. VIII. fig. 11). Their size is 1·3 mm. Their form is elongate, having the shape of a pear. The small antennæ (*an*) are distinctly to be observed, and consist of one segment only. The body is covered by a double wall, the exterior one forming a kind of mantle. Its outer surface is clothed with very small bristles, and at one extremity, the more swollen one, the external wall has an opening. The only organ which is well developed is the testis (*t.*), with its receptaculum seminis (*r.s.*). The testis is very large and heart-shaped; the receptaculum seminis is relatively small, and consists of an oval sac; at one extremity it communicates with the testis, at the other with the vas deferens. I tried in vain to distinguish where this duct opened; probably it is close to the opening of the mantle.

The specimen of *Scalpellum compressum* contained eggs. These are not very numerous, but relatively large. Their shape is oval, their length about 0·8 mm.

C. Species with the carina simply bowed.

a. *With a sub-carina.*

Scalpellum acutum, n. sp. (Pl. III. fig. 19; Pl. VIII. fig. 12).

Surface of the valves smooth, not covered by membrane. Valves thirteen. Carina simply bowed, very short. Umbo of the carina at the apex. A distinct sub-carina and a distinct rostrum are present. Only two lateral valves of the lower whorl at each side.

Of this extremely interesting species three specimens were taken at Station 170, 520 to 630 fathoms, and one specimen at Station 78, 1000 fathoms.

The *capitulum* is flat and elongate, and consists of thirteen valves. Besides the carina and the three pairs of upper latera, there are a rostrum, a sub-carina, and two pairs of latera of the lower whorl. Most of the valves have an elongate and pointed shape; the umbo of the rostrum projects outwards. The capitulum is not covered by membrane; near the base, however, small parts of a chitinous covering are still adhering to the valves.

The *scutum* is parallelogram-shaped, and divided into two triangular parts by a slightly

prominent ridge. The occludent margin is straight, and so are the other margins, with the exception of the lateral margin, which is slightly convex.

The *tergum* is elongate and triangular. The occludent margin is slightly convex, the apex a little recurved; the scutal margin is divided into two parts, describing together a very obtuse angle.

The *carina* is short, simply bowed; sides almost wanting, only slightly developed in the superior part. There is no flat roof, the valve being distinctly keeled.

The *upper latus* is trapeziform. The quadrangular part is enclosed between the scutum, the tergum, and the carina; the undermost and triangular part between the scutum and the carinal latus.

The *rostrum* is very large, much larger than the rostral pair of latera; it is internally concave and externally carinated; it is rhomboid, with the umbo at the apex, and resembles much the same part in *Scalpellum rostratum*.

The *rostral latus* is triangular and shorter than the rostrum, which valve it slightly overhangs.

The *carinal latus* is quadrangular, rhomboid. It is divided into two triangular parts by a prominent ridge running from the apex. The area of these valves almost equals that of the rostrum, and surpasses that of the rostral latus.

The *sub-carina* is triangular and rather small. The apex lies over the base of the carina.

Length of the capitulum, 5·5 mm.

The *peduncle* is narrow, only slightly wider near the capitulum, totally covered by very small scales, the free edges of which are rounded. The rows formed by the scales are not very regular.

Of one of the specimens I made a preparation of the *mouth*, which I figure on Pl. VIII. fig. 12. The mouth is not so bullate as in the other species; its opening is directed backwards. The œsophagus is narrow but very long; the supra-œsophageal ganglion is small and situated close to the cardia. The œsophageal commissure is very long, and the first ganglion of the ventral chord is large, the second a great deal smaller.

The first *cirrus* is elongate, its two branches are very unequal in length, but they are both very slender. The longest branch has ten, the shortest, eight segments. The oviduct opens at the base of this cirrus; it has a distinct swelling near its extremity, which no doubt corresponds to the well-known organ containing the so-called auditory sac in *Lepas*. Within this swelling, in the present species also, a small sac was observed.

Caudal appendages uniarticulate.

This curious species was observed at Station 78, July 10, 1873; lat. 37° 24′ N.; long. 25° 13′ W.; depth, 1000 fathoms; bottom, Globigerina ooze. Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; depth, 520 fathoms; bottom temperature, 6° C.; bottom, rocky. Lat. 29° 45′ S., long. 178° 11′ W.; depth, 630 fathoms; bottom temperature, 4° C.; bottom, rocky.

Observations.—This species is one of those which were collected at Stations situated far from one another. Whereas one Station is in the Atlantic, near the Azores, the other is in the Pacific, near the Kermadec Islands.

B. *Without a sub-carina.*

(A.) Species with a rostrum.

Scalpellum brevecarinatum, n. sp. (Pl. III. fig. 22).

Valves fourteen, covered by a very thin membrane only. Carina very short, simply bowed, with the umbo at the apex. Upper latus quadrangular. Valves of the lower whorl, and especially the carinal latera, large. Rostrum wedge-shaped.

Of this curious little deep-sea species two large and three very small and young specimens were collected. They agree with *Scalpellum balanoides* in the shortness of the carina.

The *capitulum* is flat, and consists of fourteen valves covered by a very thin chitinous membrane; in consequence of this the white colour of the valves has become slightly yellowish. The high development of the valves of the lower whorl is especially characteristic of this species.

The *scutum* is trapeziform; about twice as long as broad. The apex is slightly recurved, and projects over the tergum as a small triangular part. The occludent margin is arched, the lateral margin also; the tergal margin behind the projecting triangular part is straight.

The *tergum* is triangular; its occludent margin arched; the apex is recurved, the carinal margin slightly arched, the scutal margin almost straight. It surpasses the scutum in area.

The *carina* is short, simply bowed. The umbo is at the apex. The roof is not quite flat, and slightly furrowed longitudinally. In the uppermost portion small parts which must be considered as sides are visible.

The *rostrum* is elongate, narrow. The umbo is at the upper extremity, which is slightly narrower than the base.

The *rostral latus* is trapeziform. The scutal margin is much longer than the basal margin. The latter is straight, the former slightly hollowed out.

The *infra-median latus* has about the same shape as the rostrum. It is slightly protuberant over the surface of the other latera. Its umbo is at the upper extremity.

The *carinal latus* is very large and of an elongate pentagonal shape. The lateral margin is long and straight, the basal margin is rather short; the carinal margin is divided into a superior portion which is hollowed out, and into a rather long and slightly convex

inferior portion; the upper margin is straight. The umbo projects slightly over the carina. The two carinal margins touch one another over a long distance beneath the carina.

Length of the capitulum, .7 mm.

Peduncle short, conical. Scales large, calcareous; the edges very prominent. They are not numerous, and are placed in horizontal rows; vertically no distinct rows can be made out.

I opened one of the specimens, but the animal had been destroyed. I opened a second; it had the animal still within it, but its condition was very poor. So I am able to give only the following information.

The *labrum* is bullate; its free edge is furnished with a row of small but distinct and pointed teeth; the palpi are not very elongate, rather robust, furnished with hairs not only at the extremity but also at the sides. The *mandibles* have three teeth and a very short inferior angle, which is strongly pectinated. The *maxillæ* have the edge nearly straight; only a trace of a notch behind the very broad upper spines. The *outer maxillæ* have the bristles not divided into separate tufts. The so-called olfactory orifices are not placed on highly protuberant excrescences.

The first pair of *cirri* has unequal branches. The most anterior one is shorter and very thick, the posterior one is much more elongate; the latter has seven, the former five segments. A distinct interval separates the first cirrus from the five posterior pairs, which are much more elongate.

The *caudal appendages* are uniarticulate.

I found in one of the specimens a small complemental male attached to the interior surface of each scutum near its occludent margin. They were not in a condition fit for investigation.

This species was taken at two Stations, which, however, are close to one another:— Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; depth, 1375 fathoms; bottom temperature, 1°·5 C.; bottom, Globigerina ooze. One specimen. Station 147, December 30, 1873; lat. 46° 16′ S., long. 48° 27′ E.; depth, 1600 fathoms; bottom temperature, 0°·8 C.; bottom, Globigerina ooze. Three specimens.

Scalpellum parallelogramma, n. sp. (Pl. III. figs. 15, 16, and Pl. IX. figs. 1–5).

Surface of the valves covered by yellowish, chitinous membrane. Valves fourteen. Carina simply bowed, massive, with the umbo at the apex; the flat roof is bordered on each side by a distinct ridge, the flat sides are at right angles with the roof, which considerably increases in width from the upper to the lower end. Upper latera quadrant-shaped, with the arched side notched. Rostrum wine-glass shaped. Peduncle very short. Males three.

This is a very characteristic species, a dozen specimens of which were collected by the Challenger.

The *capitulum* consists of fourteen valves, and is robust; without the carina it has the shape of a parallelogram, hence the name which I propose for it. It has a considerable thickness at the lower end, but grows more compressed towards the upper end. The capitulum is covered by a strongly adhering yellowish chitinous membrane. The lines of growth are not very distinct.

Scutum more than twice as long as broad, trapeziform, the occludent and the lateral margins being parallel to each other. The umbo is situated at the apex, which slightly projects over the tergum; tergal margin slightly hollowed out. At the angle which the tergal margin describes with the lateral margin, a small projection is formed. The basal margin is straight.

Tergum triangular, flat, with a short and slightly arched occludent margin. Apex a little recurved, basal angle pointed. The area covered by the tergum smaller than that covered by the scutum.

Carina simply bowed, with a flat roof, increasing considerably in breadth from the upper to the lower end. On each side the roof is bordered by a strong ridge. Sides nearly at right angles with the roof, of equal breadth over its whole length, only growing narrower at the lower extremity.

Upper latus quadrant-shaped, with a not very deep notch cut out of the basal margin, which notch receives the upper margin of the carinal latus.

Rostrum minute, hour-glass shaped, the upper part being quadrangular, the lower being elongated-triangular; inserted like a wedge between the umbones of the rostral latera, so as to be easily overlooked.

Rostral latus quadrangular, the basal margin with a projecting ridge and slightly rounded.

Infra-median latus triangular and large. The under part on both sides is furnished with a kind of ala; the middle and under part formed by the inferior angle of the triangle projects considerably beyond the surface of the capitulum.

Carinal latus elongated, appears as if formed of two valves united together, both of a triangular shape with slightly curved sides. The umbo of the carinal latus projects very much beyond the line of the carina and also beyond the surface of the capitulum.

Length of the capitulum, about 21 mm.

Peduncle short (4 mm. in a specimen of 21 mm.), cylindrical, of the same width over its whole length, almost entirely smooth, at least not furnished with calcareous scales as in the other species.

Mouth.—Labrum with the upper and anterior part very bullate. *Palpi* small, almost triangular, not very slender. *Mandibles* (Pl. IX. fig. 1) with three teeth, the second and third smaller than the first. Inferior angle broad, pectinated. *Maxillæ* (Pl. IX. fig. 2) with a very deep notch behind the upper great spines, and about seven pairs of rather

equal spines at the nearly straight inferior portion of the free edge. *Outer maxillæ* (Pl. IX. fig. 3) with the bristles spread over the whole surface; one tuft, however, may be distinguished near the base on the anterior margin. The maxilla has a large rounded swelling directed forward, and a second smaller one at the back above the protuberances which bear the olfactory orifices (?) at their extremity.

The first pair of *cirri* has very unequal rami. The most anterior one has eight very broad segments, the posterior ramus has ten much more elongate segments. The surface of the segments is thickly clothed with very slender spines. At the base of the first cirrus the opening of the oviduct (Pl. IX. fig. 4, *g.o.*) is seen. It is placed below a small cover, of which it forms the hinder edge. The oviduct itself forms a swelling at the extremity, and a second even more prominent one a little before the extremity. This latter swelling (Pl. IX. fig. 5) contains a rounded bag, which no doubt corresponds to the auditory sac, as Darwin calls it, which in *Lepas* has the form of a little shoe.

The *caudal appendages* are elongate and multiarticulate. Those of the specimens I investigated were composed of seven segments.

Eggs large, 0·75 mm. in length, oval. The number of eggs contained in a specimen is not very large.

This species was taken at Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 2°·7 C.; bottom, hard ground.

Observations.—This beautiful species is an inhabitant of the southern Atlantic Ocean. It lives attached to a coral of the genus *Dendrophyllia*. When complemental males are present, they are found in a considerable number (five or six) at the ordinary place. In shape the complemental male much resembles that of *Scalpellum compressum*. However, it is different, in as far as it is enclosed in a very tough, horny membrane, the mantle with the microscopic spines being found under this membrane.

Scalpellum album, n. sp. (Pl. III. figs. 20, 21).

Valves fourteen, white, smooth, interspaces between the valves broad. Carina simply bowed, with the umbo at the apex. Rostrum oval, rather large. Upper latus quadrangular, narrow.

This slender deep-sea species is represented by two specimens, the one probably full-grown, the other a great deal smaller and still young.

The *capitulum* is elongate, slender. At its base it has the same breadth as the peduncle, and it reaches its greatest width near the middle of the carina. The surface of the valves is smooth, only here and there chitinous fibres adhering to it. When studied with the microscope, the beautiful striation of the valves distinctly appears. The different valves, and especially the scutum, upper latus, and carina, are separated by

broad chitinous interspaces, which give the animal a very characteristic appearance. The capitulum consists of fourteen valves; there is a distinct rostrum, but no subcarina.

The *scutum* is elongate, very narrow, especially towards its upper extremity, hence almost triangular. The occludent margin is straight, the lateral margin also; the latter passes with a very obtuse angle into the short tergal margin. The basal margin is short. The umbo is at the apex, which projects considerably over the tergum.

The *tergum* is triangular, not very large, rather slender, obtusely pointed at the under extremity.

The *carina* is well developed, simply bowed, with the umbo at the apex. The apex reaches as far as half the length of the carinal margin of the tergum. The carina has no flat roof, being distinctly carinated; laterally it is regularly bowed, so as to show a semicircular line on section.

The *upper latus* is quadrangular and elongate. Its scutal margin is hollowed out, its tergal margin is short and straight; its carinal margin is straight also. The undermost part of the valve, which penetrates between the infra-median and the carinal latera, is a great deal narrower than the upper part.

The *rostrum* is relatively large, and has an oval shape. It is covered on either side by the free edges of the rostral latera, which touch each other in a single point beneath the occludent margins of the two scuta.

The *rostral latus* is quadrangular, with the rostral margin arched, and the scutal margin straight and a great deal longer than the basal margin; the lateral margin is large and slightly hollowed out.

The *infra-median latus* is elongate, triangular, with the umbo at the apex. The valve is distinctly protuberant beyond the surface of the two adjoining latera.

The *carinal latus* is relatively large, and has the umbo at the apex. Its carinal margin is distinctly arched, its upper margin hollowed out. The lateral margin is straight, and so is the basal margin. A very prominent ridge divides the valve into two triangular parts. The apex is considerably curved to the front, so as to touch the carinal-basal angle of the upper latus.

Length of the capitulum, 13 mm.

The *peduncle* is conical, being a great deal narrower near its attachment than near the capitulum; with the valves of the lower whorl the peduncle forms a kind of calyx for the reception of the other valves. The peduncle is covered by calcareous scales placed in six longitudinal rows, each containing about seventeen scales. The peduncle with its rows of scales has undergone a slight torsion.

Of this species I have not studied the structure of the animal enclosed within the capitulum; nor have I been fortunate enough to observe a complemental male at the place it ordinarily occupies.

This species was dredged at Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; depth, 500 fathoms; bottom temperature, 5°·3 C.; bottom, Globigerina ooze.

Observations.—This species from the Malay Archipelago, off Meangis Islands, is easily to be recognised, as well by the form of the capitulum as a whole, as by the shape of the different valves.

Scalpellum africanum, n. sp. (Pl. VI. fig. 14).

Valves fourteen, not separated by chitinous interspaces, covered by very thin membrane, which bears very minute hairs. Carina simply bowed, with the umbo at the apex; short, very broad near its inferior extremity. Upper latus quadrangular. Rostrum oval. Peduncle very short.

Of this species one probably full-grown and two or three small specimens were collected.

The *capitulum* is not very elongate, it is very thick and rather swollen between the valves of the lower whorl, flat again near the upper extremity. The length of the capitulum slightly surpasses once and a half its breadth. The surface of the capitulum is covered by a very thin membrane, which is thickly clothed with very minute hairs. The lines of growth of the different valves are distinctly visible under this membrane, and this applies especially to the tergum and the valves of the lower whorl.

The *scutum* is trapeziform, with the umbo at the apex. The latter is slightly recurved and projects over the tergum. The occludent margin is arched, the basal and lateral margins are straight; the length of the valve is not quite once and a half its breadth.

The *tergum* is triangular, with the apex slightly recurved. The occludent margin is arched, the scutal margin straight, the carinal margin hollowed out at its upper half and arched at the lower extremity.

The *carina* is boat-shaped, not so deep, however, in the lower as in the upper half. It is very short, and has the umbo at the apex. It is rather broad a little above its base, and from this broadest part a short triangular portion penetrates downwards between the two carinal latera. The sides of the carina are only little developed, they are placed as narrow semi-lunar strips near the tergum.

The *upper latus* is quadrangular; its tergal, scutal, and basal margins differ only slightly in length; its carinal margin, on the contrary, is a great deal shorter.

The *rostrum* is distinct and not very small. It is oval, and its free edges are covered by the rostral latera.

The *rostral latus* is small and almost triangular by the shortness of the basal margin. The scutal margin is the longest; it is distinctly concave, and the whole valve is bowed.

The *infra-median latus* is triangular, with the basal margin broad, and the umbo at the apex

The *carinal latus* is large and nearly pentagonal. Three of the margins are of about the same length; the basal margin describes a very obtuse angle with the lateral margin; the lateral margin forms nearly a right angle with the upper margin; the carinal margin is twice as long as one of the other margins; it is divided into two portions, the superior one is slightly hollowed out, the inferior one is slightly arched, and meets that of the valve of the other side at its under extremity. The umbo is placed at the angle which the two portions of the carinal margin describe together.

Length of the capitulum of the largest specimen not quite 7 mm.

Peduncle very short, totally covered by calcareous scales. These have very prominent edges, and are placed in eight longitudinal rows, each of them consisting of only five scales.

This species was taken October 17, 1873, off Nightingale Island, at a depth of 100 fathoms (Station 135, Island of Tristan da Cunha; bottom, rock, shells).

Scalpellum hirsutum, n. sp. (Pl. IV. fig. 19).

Valves fourteen, covered by membrane, clothed with very long hairs. Carina simply bowed, umbo at the apex, roof flat. Valves of the lower whorl small. Upper latus triangular. Rostrum represented by a very narrow stripe which is distinctly visible at the surface.

This small species is represented by a single specimen only.

The *capitulum* is characterised by the long hairs which clothe the membrane covering the valves. The valves of the lower whorl are rather small, the other valves—and especially the scutum and the tergum—are elongate, with produced apices.

The *scutum* is elongate, convex; more than twice as long as broad, with the upper part produced and pointed. The pointed extremity is slightly protuberant beyond the occludent margin of the tergum.

The *tergum* is large, elongate rhomboid. The umbo is at the apex, which is considerably produced.

The *carina* is simply bowed, and has a flat roof, much increasing in width from the upper to the lower extremity. Its sides are not much developed.

The *upper latus* is almost triangular, with the carinal-basal margin arched. The apex is slightly produced and is totally enclosed between the scutum and tergum.

The *rostrum* is small, linear-shaped; enclosed between the rostral margins of the rostral latera.

The *rostral latus* is quadrangular, basal and scutal margins parallel.

The *infra-median latus* is triangular; umbo at the upper extremity.

The *carinal latus* is of an irregular shape, with the umbo near the upper extremity.

Carinal margin arched, upper margin irregularly hollowed out; lateral and basal margins straight and almost of the same length.

Length of the capitulum, 6 mm.

The *peduncle* is short (about 2 mm.). The scales are placed in longitudinal rows, and slightly prominent.

I have not been able to study the animal contained in the capitulum, nor have I observed the complemental male of this species.

This species was taken at Station 196, October 13, 1874; lat. 0° 48′ S., long. 120° 58′ E.; depth, 825 fathoms; bottom temperature, 2°·4 C.; bottom, rock.

Observations.—This is one of the cases in which it must seem rather hazardous to propose a new species for a single specimen. However, I think it will prove possible to recognise the form by the aid of the figure and of the description.

Scalpellum nymphocola, n. sp. (Pl. III. fig. 23; Pl. IX. fig. 6).

Valves fourteen, smooth, covered by very thin membrane. Carina simply bowed, with the umbo at the apex. Rostrum visible at the surface. Upper latus pentagonal. Infra-median latus quadrangular. Peduncle almost as long as the capitulum.

Numerous specimens of this species were taken in 1880, by H.M. hired ship "Knight Errant." They are also richly represented in the collections made during the cruise of H.M.S. "Triton." In both cases they were found attached to the legs of *Nymphon robustum*, Bell, a stout Pycnogonid which is common in the cold water area of the Faröe Channel, and also in higher northern latitudes. In the Faröe Channel it is a common occurrence to observe the parasite on the legs of this Pycnogonid, whereas on the legs of true Arctic specimens the *Scalpellum* (hitherto at least and as far as my knowledge goes) has never been observed.

Capitulum thick, robust, oval shaped, the tergum slightly produced. Valves fourteen; covered by very thin membrane, and not presenting distinct lines of growth. Valves separated by distinct and rather broad chitinous interspaces. Scutum and upper latus short and broad, valves of the lower whorl rather large.

Scutum quadrangular, not quite once and a half as long as broad, convex. Umbo at the apex, which projects over the tergum.

Tergum triangular, occludent margin arched and a great deal shorter than the scutal margin.

Carina simply bowed, with the roof flat and the umbo situated at the apex. The sides of the valve are well developed, and only slightly broader near the upper extremity of the valve.

Upper latus pentagonal; in full-grown specimens the tergal margin makes a right angle with the scutal and also with the carinal margin.

Rostrum narrow, linear, short; laterally it is slightly covered by the edges of the rostral latus.

Rostral latus with the umbo slightly protuberant, of an irregular quadrangular shape.

Infra-median latus stout, almost as broad as it is high, pentagonal.

Carinal latus of an irregular shape. Umbo at one-third of the height of the valve from the base, slightly protuberant. Superior part of the carinal margin hollowed out, lateral margin long and at a right angle with the basal margin.

Length of the capitulum, 7½ mm.

Peduncle cylindrical, almost 6 mm. long, slightly thicker towards the upper extremity. The scales at considerable distances from one another placed in longitudinal rows. A full-grown specimen shows about seven of these rows, each containing about nine scales. Each scale is straight near its attachment, and has a rounded free edge.

Mouth.—The anterior part of the *labrum* forms an overhanging projection; the palpi are small, short, triangular, with a tuft of spines at the extremity. The *mandibles* have three teeth, the first and the second are separated by a very deep notch; the inferior angle is broad and strongly pectinated. The *maxillæ* show a not very deep notch behind the three upper spines, two of which are greater; the portion behind the notch has the edge nearly straight, and is furnished with five or six pairs of not very unequal spines. The *outer maxillæ* have the so-called olfactory orifices placed at the end of highly protuberant stalks.

The *cirri* in this species are relatively short; the first pair shows unequal rami; the shortest one has six segments, the longer ramus eight segments. Those of the former are slightly thicker than those of the other ramus. The segments of both rami are very thickly clothed with very long spines; the shortest ramus, moreover, shows a very thick spine on the outer side of the upper edge of the third and fourth segments, and two of these stronger spines near the upper edge of the fifth segment, and three at the extremity of the last segment.

The *caudal appendages* are small, uniarticulate.

The eggs are relatively large and not very numerous.

Complemental males (Pl. IX. fig. 6) one on each side, placed in a pouch formed by the membrane which covers the scutum interiorly. Its attachment and form is much like that of *Scalpellum stroemii*. The little body itself is covered by a very thin chitinous membrane, which is delicately striated. Of the inward parts almost nothing has remained except the testis and the receptaculum seminis. I could trace also—though not very distinctly—the course of the vas deferens, but I failed to distinguish the place where it opens.

Of this species great numbers were taken:—Cruise of the "Knight Errant."—Station 8, August 17, 1880; lat. 60° 3′ N., long. 5° 51′ W.; depth, 540 fathoms; cold area.

Cruise of H.M.S. "Triton."—Station 8, August 22, 1882; lat. 60° 18′ N., long. 6°15′ W.; depth, 640 fathoms; bottom, mud; temperature,—1°·1 C. Station 9, August 23, 1882; lat. 60° 5′ N., long. 6° 21′ W., depth, 608 fathoms; bottom, mud; temperature,—1°·1 C.

Observations.—In both cases the specimens were found attached to the legs of *Nymphon robustum*, Bell. However, we must not consider them as parasites of this species; the slowly moving legs of the Pycnogonid are for the Cirriped what branches of Bryozoa, Corals, &c., are for other species of *Scalpellum*.

This species comes very near to *Scalpellum angustum*, G. O. Sars. However, it is different in the shortness of the rostrum, which is covered on both sides by the rostral latera, and also in the form of the scales of the peduncle, which are placed at considerable distances from one another, and do not cover each other as roof-tiles do ("squamis sat magnis, niveis, vix imbricatis tectus," G. O. Sars; see also the figure of Heller, *loc. cit.*, Taf. iv. figs. 13, 14). The shape of the valves of the lower whorl is also different from those as figured by Heller. From *Scalpellum striolatum*, G. O. Sars, and *Scalpellum cornutum*, G. O. Sars, it is easily distinguished by the elongate form of the capitulum and the peduncle, and also by the shape of the infra-median latus.

Scalpellum rubrum, n. sp. (Pl. IV. fig. 18).

Valves fourteen, smooth, beautifully white and red coloured. Carina simply and strongly bowed, with a slightly convex roof and with the umbo at the apex. Rostrum triangular, distinct. Upper latus quadrangular, large. Valves of the lower whorl small. Infra-median latus triangular. Peduncle with very prominent ridges.

This very small species is represented by a single specimen.

The *capitulum* is flat, rather broad, and consists of fourteen valves. These are not covered by distinct membrane; those of the lower whorl are small, those of the upper part comparatively large.

The *scutum* has much the ordinary shape. Its occludent margin is arched, and forms with the tergal margin a triangular portion which projects over the tergum.

The *tergum* surpasses the scutum in area. Its carinal margin is much arched, its occludent margin almost straight.

The *carina* is well-developed, simply and rather strongly bowed; the roof is not quite flat, but laterally slightly convex. The sides are only slightly developed in the uppermost part.

The *upper latus* is quadrangular; the angle at the apex between the scutal and tergal margins distinctly projects over the scutum.

The *rostrum* is small, yet distinct. It has a triangular shape, its base being directed towards the peduncle.

The *rostral latus* is very low, quadrangular, the scutal margin nearly parallel to the basal margin.

The *infra-median latus* is small, triangular, and has the umbo at the apex.

The *carinal latus* is larger than the other latera of the lower whorl. Its carinal margin is arched, its upper margin hollowed out. Where the two margins meet, the umbo is situated; it is distinctly curved to the front. The lateral and basal margins are almost of the same length.

Length of the capitulum, about 5 mm.

The *peduncle* is about one-third the length of the capitulum, cylindrical; furnished with four longitudinal rows of very prominent scales, each row containing about five of these scales.

This species was taken at Station 204, November 2, 1874; lat. 12° 43′ N., long. 122° 10′ E.; depth, 100 fathoms and 115 fathoms; bottom, mud (near Luzon).

Observations.—The circumstance that only a single specimen of this species has been obtained makes it impossible to enter into details as to the structure of its mouth, cirri, &c. A complemental male was not present.

Scalpellum truncatum, n. sp. (Pl. V. fig. 13).

Surface of the valves naked, with very prominent ridges; valves fourteen, closely locked together. Carina simply and feebly bowed, with the umbo at the apex, and with the roof flat, much increasing in width from the upper to the lower extremity, bordered on each side by a very prominent ridge. Rostrum hardly visible. Tergum truncated. Upper latus trapeziform.

This species is represented by a single specimen. Its shape is a very characteristic one, on account of the truncated form of the tergum, the occludent margin of which describes an angle with the occludent margin of the scutum.

Capitulum very flat; consisting of fourteen valves. Valves entirely naked, with very distinct ridges and furrows over the surface; capitulum not very elongate, and having its greatest breadth about the scutal angle of the tergum.

Scutum with the umbo at the apex, which projects over the tergum; occludent margin almost entirely straight; basal margin short, at a right angle with the occludent margin; lateral margin convex; tergal margin slightly hollowed out. Valve divided into two triangular parts by a rather prominent ridge, which runs from the apex to the basal-lateral angle.

Tergum triangular; the occludent and scutal margins describe an angle of 90°. The scutal margin slightly undulating, the true scutal part being convex, the other hollowed out. The carinal margin is arched. The umbo is at the apex, where the occludent and carinal margins describe a rather obtuse angle.

Carina simply, though slightly, bowed. Roof flat, bordered by very prominent ridges, and increasing considerably in width from the upper to the lower extremity. Sides not very much developed, though slightly broader in the upper part of the valve.

Upper latus trapeziform, with the carinal margin straight and short, the scutal margin rather long and hollowed out, the tergal margin straight. The umbo is at the apex, which projects over the scutum. The scutal-basal angle is slightly truncated.

Rostrum extremely narrow, slightly increasing in width near the beginning of the occludent margin of the scutum.

Rostral latus quadrangular, with the scutal and basal margins parallel to each other, divided into two triangular parts by a ridge running from the umbo to the basal-lateral angle. Umbo slightly projecting over the occludent margin of the scutum.

Infra-median latus triangular, not very elongate, with the umbo at the apex, which is a little curved forward.

Carinal latus of a very irregular shape; a large triangular part is enclosed between the carina and the basal margin of the upper latus; the other part is quadrangular, with the umbo seated at the base of the carina, and slightly projecting over the hinder margin of the capitulum.

Length of the capitulum, 10·5 mm.

Peduncle short and cylindrical; about one-fourth the length of the capitulum. The scales are not very numerous nor very prominent. They do not form very regular rows, though three or four are placed longitudinally.

This beautiful deep-sea species was taken at Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; depth, 1400 fathoms; bottom temperature, 1°·8 C.; bottom, grey ooze.

Observations.—As only a single specimen of this species has been collected, my description is limited to the form of the capitulum and its valves. I do not doubt but that it will be possible to recognise the species with the aid of that description and of the figure.

Scalpellum elongatum, n. sp. (Pl. IV. figs. 8, 9).

Surface of the valves in full-grown specimens not covered by membrane, distinctly striated. Valves thirteen, or fourteen when the hardly visible rostrum is counted also. Carina simply bowed, with a flat roof deeply furrowed longitudinally, and with sides at right angles with the roof and well developed. Umbo of the carina at the apex. Upper latus quadrilateral, with straight sides. Lower whorl of the valves highly developed. Peduncle very short. Males numerous.

This is a beautiful species with a very flat capitulum. Its length is partly the consequence of the great development of the valves of the lower whorl. It is repre-

sented by a single full-grown specimen only. Though with hesitation, I refer also to it three other specimens taken at two different Stations.

The *capitulum* consists of thirteen valves. Between the two rostral sides of the rostral latera an extremely narrow calcareous streak is observed, which no doubt represents the rostrum, but which can hardly be said to be distinctly visible. In the largest specimen the surface is almost entirely naked; in the specimen which comes next in size, the surface is covered by a membrane richly furnished with woolly hairs. The smaller specimens from Station 169 are also hairy. As the shape of the valves, and especially the high development of the valves of the lower whorl, is the same in all these specimens, I feel inclined to consider the difference in hairiness as due to difference in age.

The *scutum* is large, quadrilateral, twice as long as broad. The lateral margin is straight, the basal margin slightly arched, the tergal margin straight, and has near the convex occludent margin a small triangular projection over the tergum. The umbo is at the apex. The lines of growth have two directions, and meet in a curved line running from the apex to the angle formed by the basal and lateral margins. The striæ are almost at right angles to the lines of growth.

The *tergum* is triangular, flat, large, with the three margins almost entirely straight; the carinal margin is the only one which makes an exception, as it is slightly convex in the undermost and slightly hollowed out in the uppermost half of its length. The striæ are diverging from the apex to the scutal margin; the lines of growth run parallel to the scutal margin. The umbo is at the apex.

The *carina* is simply bowed, with the umbo at the apex, and the roof deeply furrowed and bordered by strongly-developed lateral ridges. The roof increases considerably in width from the upper to the lower end; the two sides are flat and at right angles with the roof, they have the same width over their whole length.

The *upper latus* has the form of a trapezium, the carinal margin being almost exactly parallel with the scutal margin. The latter is three times as long as the former. The tergal margin has the same length as the basal margin. All the margins are straight and the umbo is at the apex. The lines of growth in the one part run parallel with the basal, and in the other parallel with the carinal margin.

The *rostrum* is not distinct.

The *rostral latus* is—when seen laterally—triangular; its real shape, however, is rather trapeziform. The umbo is at the rostral extremity, where the valve projects over the base of the scutum. The scutal margin is the prolongation of the basal margin of the upper latus. The hind margin is convex, and imperceptibly passes over into the short basal margin.

The *infra-median latus* is triangular, with the umbo situated at the apex, and the basal margin broad. The rostral and carinal margins are slightly hollowed out.

The *carinal latus* is very large, with the umbo seated at the basal outer angle; the

lateral and carinal margins run exactly parallel with each other, the lateral one being convex and passing over imperceptibly into the basal margin. The carinal margin is hollowed out. The carinal latera of the two sides meet each other under the middle of the carina. The valve is divided into two parts by a distinct concave ridge, running from the apex to the anterior basal angle of the valve.

Length of the capitulum, about 24 mm.

The short *peduncle* (5 mm.) shows well-developed and large scales. These are placed in six longitudinal rows, each row containing about seven scales.

As I did not wish to sacrifice the full-grown specimen, which has served for the above description of the exterior, I am not able to publish details of the structure of the mouth, &c. To give them from the smaller specimens does not appear to me to be a safe way.

The three Stations where this species was collected are the following:—Station 135, October 16 to 18, 1873; Island of Tristan da Cunha; depth, 60, 75, 100, 150, 550, 1000, 1100 fathoms; bottom—rocky, shells. Station 164A, off Sydney, June 13, 1874; lat. 34° 13′ S., long. 151° 38′ E.; depth, 410 fathoms; bottom, grey ooze. Station 169, off East Cape, Auckland, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 4°·2 C.; bottom, grey ooze.

Scalpellum antarcticum, n. sp. (Pl. IV. figs. 16–17).

Capitulum covered by membrane, furnished with numerous though very small spines. Valves thirteen. Carina simply bowed, with the umbo at the apex and with a flat roof. Upper latus quadrangular. Umbo of the carinal latus almost at the base of the valve. Peduncle cylindrical, narrower than the base of the capitulum.

This is the most southern species of the genus taken by the Challenger. It is a medium-sized species, and it is represented by a single specimen only.

The *capitulum* is rather robust, convex. It contains thirteen valves; there is a trace of a fourteenth (the rostrum), but it is too rudimentary to be noticed. The valves are covered by a brown chitinous membrane, which bears numerous very small spines. Between the valves there are very narrrow chitinous interspaces.

The *scutum* is quadrangular, with the umbo at the apex. The whole valve is convex, especially in the undermost part. The occludent margin is arched, the lateral margin also; the basal margin is slightly arched, almost straight; the tergal margin, finally, is hollowed out.

The *tergum* is triangular, of a greater area than the scutum, with the apex recurved. The occludent margin is slightly arched.

The *carina* is rather stout. Its umbo is at the apex, and the whole valve is simply bowed. It has a flattened roof, which does not increase very much in width from the

upper to the lower extremity. The sides of the carina are at more than right angles with the roof; they increase much in width from the lower to the upper extremity.

The *upper latus* is quadrangular, with the lower angle truncated, hence pentagonal. The umbo is at the apex, which is slightly prominent. The scutal margin is hollowed out, the tergal margin slightly arched.

The *rostral latus* is of considerable size, quadrangular. Scutal and basal margins nearly parallel; the whole valve is distinctly convex and divided into two triangular parts by a not very prominent ridge running from the umbo to the basal lateral angle.

The *infra-median latus* is small, triangular. The umbo is at the slightly protuberant apex.

The *carinal latus* has an irregular shape, resembling that of a shoe. The umbo is at the carinal basal angle and represents the heel of the shoe. The carinal margin (the sole of the shoe) is slightly hollowed out. The upper margin is straight, the lateral margin is very short, the basal margin straight, only slightly upturned towards the umbo.

Length of the capitulum, 20 mm.

The *peduncle* is short (5·5 mm.), cylindrical, much narrower than the base of the capitulum.

The scales are covered by membrane, very narrow, transverse, calcareous stripes only being visible. They are not numerous, and do not form very distinct rows; they are at considerable distances from one another.

This species was taken at Station 153, February 14, 1874; lat. 65° 42′ S., long. 79° 49′ E.; depth, 1675 fathoms; bottom, mud.

Observations.—This species may be easily distinguished from the nearly related *Scalpellum velutinum*, *Scalpellum pedunculatum*, &c., by the form of the carinal latus. Though this valve also may perhaps present variations within the limits of a species, in the present case it can be safely made use of.

Scalpellum velutinum, n. sp. (Pl. IV. figs. 10, 11; Pl. IX. figs. 7–9).

Surface of the capitulum and of the peduncle covered by a velvet-like membrane. Valves fourteen, the rostrum, however, not visible at the surface. Carina simply and very strongly bowed, with the umbo at the apex, with a flat roof, the apex of which penetrates between the two terga. Upper latus triangular.

This beautiful species is represented by a single specimen. Provisionally there must be referred to the same species three smaller specimens, which were dredged near the southern point of Portugal; yet I am not quite sure that they belong really to the same species. This species is nearly related to *Scalpellum regium*, *Scalpellum darwinii*, *Scalpellum gigas*, *Scalpellum robustum*, &c., which form together a very natural group.

The *capitulum* has fourteen valves, and is rather robust; the scutum, tergum, and carina are large; the valves of the lower whorl are relatively small. The valves touch each other, and are covered by a distinct membrane with velvet-like hairs.

The *scutum* is exactly twice as long as broad, and distinctly convex. The umbo is at the apex, which slightly projects over the occludent margin of the tergum. The occludent margin is slightly convex, the tergal margin slightly hollowed out near the apex, the lateral margin is again convex, the basal margin straight.

The *tergum* is very large, rather narrow, with the carinal and scutal margins convex, the occludent margin hollowed out, and the umbo at the apex, which terminates bluntly.

The *carina* is simply bowed, with a flat roof widening much from the apex to the base. The umbo is at the apex, which penetrates rather far between the two terga. The borders of the roof are furnished with a not very prominent ridge; the sides are at less than right angles with the roof of the carina. They increase in breadth from the apex to the base.

The *upper latus* is triangular, the basal margin is feebly convex, the scutal and tergal margins are nearly equal; the umbo is at the apex.

The *rostrum* is very small and totally covered by membrane; it has a triangular shape, its apex being separated from the two scuta by the umbones of the rostral latera, which touch each other in front of the rostrum.

The *rostral latus* is broad but very low; the basal margin is almost parallel with the scutal margin.

The *infra-median latus* is triangular, with the umbo at the apex.

The *carinal latus* is of a very irregular shape, robust. Its carinal margin is divided into two portions, the superior one being hollowed out; the upper margin is also hollowed out for the reception of the convex margin of the upper latus. The umbo is at the hindermost point of the carinal margin, and projects a great deal outwards. The inferior portion of the carinal margin of the valve is convex, and meets the same portion of the margin of the valve of the other side beneath the middle of the carina. From the umbo arises a ledge, which divides the valve into two parts,—the true lateral and a carinal part. Between the latter and the carina a distinct cavity—a kind of bag—is formed.

Length of the capitulum, 33 mm.

The *peduncle* is robust, nearly cylindrical, and has a length of 12 mm. The scales are for the greater part covered by membrane, the edges only being calcareous. The membrane is villous, as on the capitulum. The scales are numerous, a dozen being placed in each longitudinal row, of which there are about ten. Their number cannot be distinctly made out, the longitudinal rows running rather obliquely.

In general this description holds good also for the three small specimens dredged at Station 3. They differ slightly from the typical specimen described above in the form of the carinal latus, and much more with regard to the number of scales of the peduncle. The

first distinction, viz., that the carinal latus is flatter and has the umbo not so far projecting outwards, may arise from the difference in age, hence in size. Yet the largest specimen of the three is probably a full-grown one, as it is furnished with a complemental male at each side. The difference in the number of scales of the peduncle is very considerable. Whereas the number of horizontal rows is about equal to that of the full-grown specimen of Station 335, the number of scales in each horizontal row is only three or four.

The complemental males of this species are relatively large; there are not more than one on each side. One of these (attached to the left hand scutum of the largest specimen of Station 3) is still in the pupa-stage. I have figured it Pl. IX. fig. 7. It has all the characteristics of a true pupa of a Cirriped; however, one feels inclined to say that the interior of the body is only feebly developed. The specimen figured in Pl. IX. fig. 8 has been taken from the right hand scutum of the full-grown *Scalpellum velutinum* from Station 335. In this male the retrogressive metamorphosis is already far advanced. The body is covered by a mantle clothed with numerous slender spines, and having two openings or slits, one anteriorly, through which the prehensile antennæ are stretched forth, and the other at the posterior extremity, which lets out a tuft of very delicate hairs. These hairs were originally attached to the six pairs of rowing feet of the pupa, but of these feet only the exuviæ are still visible. Of the interior of this young male the testis (*t.*), with a part of the vas deferens, is easily distinguished, and so are two glandular bodies, which, to judge from their position, probably represent the cement glands (fig. 8, *c.gl.*). The complemental male taken from the right side of the largest specimen from Station 3 is a well-developed one. At least its metamorphosis is finished, and the body, enclosed by the mantle with its slender spines, contains a large testis, with well-developed receptaculum seminis. I have figured this male in fig. 9 of the same plate. With regard to the size of the different stages, the length of the pupa-stage of fig. 7 is 1·3 mm.; the more advanced pupa-stage of fig. 8 measures only 1·1 mm., and the well-developed male of fig. 9, 1·2 mm. So we see that the size during the retrogressive metamorphosis slightly diminishes.

When we consider 1st, that it has been proved that in *Scalpellum stroemii*, Sars, the metamorphosis of the Nauplius-larva into the Cypris takes place within the mantle cavity of the mother; 2nd, that a larva in the Cypris-stage in different species of the genus *Scalpellum* (*Scalpellum velutinum*, *Scalpellum eximium*, &c.) has been observed at the place occupied also by the complemental male; and 3rd, that stages forming a link between the larva and the male itself have been observed at the same place—we may trace the life-history of these males in the following words:—

a. Species of the genus *Scalpellum* (whether all of them, or only those which inhabit the deep sea, cannot be said with certainty) have lost the Nauplius as a free swimming larval stage.

b. After the metamorphosis into the Cypris-stage, some of them become

attached to the interior side of the scutum of a female specimen near the occludent margin.

c. Whereas in the shallow-water species (*Scalpellum peronii*, Gray, sp.) these Cypris-larvæ develop into a small male animal, with a distinct capitulum and peduncle, in many deep-sea species they develop by retrogressive metamorphosis into a male of a much more rudimentary condition.

d. Neither in the first nor in the second case can it be said that unisexuality is observed in a stage which corresponds to the Cypris-stage of the ordinary development (see p. 17).

This species was taken at Station III. January 15, 1873; lat. 37° 2′ N., long. 9° 14′ W.; depth, 900 fathoms; bottom, Globigerina ooze. Station 335, March 16, 1876; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom temperature, 2°·3 C.; bottom, Globigerina ooze.

Observations.—The two Stations from which this species was obtained are both in the Atlantic; the one (near Cape St. Vincent) has about the same northern latitude as the other (north of Tristan da Cunha) has southern latitude.

Scalpellum pedunculatum, n. sp. (Pl. VI. figs. 1, 2).

Valves fourteen, covered by membrane, clothed with numerous spines. Carina simply bowed, with the umbo at the apex and with the roof flat. Upper latus quadrangular, having the form of the sector of a circle. Carinal latus standing out very much beyond the surface of the carina.

This species is represented by a single specimen only; it belongs to the same division as, and is nearly related to, *Scalpellum velutinum*.

Capitulum triangular in outline, thick, especially near the peduncle. The valves of the lower whorl are very small and short. All the valves are covered by chitinous membrane bearing slender spines all over its surface. The number of valves is fourteen.

Scutum quadrangular, little more than once and a half as long as broad; apex slightly produced, and projecting over the tergum. Occludent margin arched.

Tergum triangular, occludent margin straight, carinal margin much arched, scutal margin slightly arched. In area the tergum slightly surpasses the scutum.

Carina with a flat roof, not very much increasing in width from the upper to the lower end, sides of the valve well developed, at angles greater than 90° with the roof of the valve. The sides increase in width from the upper to the lower end. Carina simply bowed, apex penetrating between the two terga, at a short distance from their apex.

Upper latus having the shape of the sector of a circle, though when looked at accurately, the basal and the carinal margins are seen to form an angle together, whence the valve is quadrangular. Scutal and tergal margins almost of the same length.

Rostrum very small, almost entirely hidden by membrane.

Rostral latus broad, but very low. Scutal and basal margins almost parallel.

Infra-median latus small, triangular; umbo at the apex, which is slightly protuberant over the surface of the capitulum.

Carinal latus of a very curious triangular shape. The umbo is protuberant beyond the surface of the capitulum, and stands out also laterally beyond the surface of the carina. The two carinal latera meet one another at the base of the carina.

Length of the capitulum, 18·5 mm.

Peduncle long (about as long as the capitulum), cylindrical, growing wider near the capitulum. It is covered by membrane clothed with spines. The scales are totally covered by this membrane, except in the lower part, near the attachment, where they project over the surface.

As this species is represented only by a single specimen, I have not studied its internal structure. I have also failed to observe the complemental male. The species inhabits the Pacific Ocean, near New Zealand, and was taken at Station 167, June 24, 1874; lat. 39° 32′ S., long. 171° 48′ E.; depth, 150 fathoms; bottom, grey ooze.

Observations.—This species is very nearly related to *Scalpellum velutinum, Scalpellum eximium, Scalpellum gigas, Scalpellum darwinii*, &c. Whereas all these species were taken at very considerable depths, *Scalpellum pedunculatum* is an inhabitant of rather shallow water.

Scalpellum eximium, n. sp. (Pl. IV. figs. 6, 7; Pl. IX. fig. 10).

Surface of the valves only partly covered by a chitinous and smooth membrane. Valves fourteen. Carina simply bowed, with a very broad flat roof, and with the umbo at the apex. Upper latus having the shape of the sector of a circle. Peduncle medium-sized, with very strong scales.

Of this splendid species only a single specimen was dredged; it belongs to the same group as *Scalpellum gigas, Scalpellum regium, Scalpellum darwinii, Scalpellum velutinum*, &c.

The *capitulum* is very robust, and is only partly covered by a thin chitinous membrane. There are slight interspaces between the different valves; a little broader is the interspace between the carina and the adjoining parts.

The *scutum* is quadrilateral and convex. The length is not quite twice the breadth. The umbo is at the apex, which slightly projects out of the occludent margin. From the

umbo to the angle where the basal and lateral margins meet, a curved line, with its hollow side towards the upper latus, marks the place where the valve is thickest; the lines of growth, which are rather distinct and run parallel to the basal and lateral margins, start from this curved line. The occludent margin is much arched, the tergal margin is hollowed out, the lateral margin is slightly arched, the basal margin is straight.

The *tergum* is very large, and has a much greater area than the scutum. It has an oval shape with a pointed apex and basal extremity. It is divided into two longitudinal parts by a slightly curved line running from the apex to the under angle. The lines of growth starting from this line run parallel to the scutal and carinal margins. The occludent margin is straight, the carinal margin arched; the scutal margin near the scutum is arched, near the upper latus hollowed out.

The *carina* is simply but very strongly bowed, the apex is at one-third of the length of the carinal margin of the tergum from the apex of the tergum. The roof is almost flat, being only slightly unequal through a not very distinct longitudinal ridge over the middle of the valve. On both sides the roof is bordered by a very distinct longitudinally furrowed ridge; the lateral parts of the valve are almost at right angles with the roof. The basal part of the roof of the carina is triangular, and penetrates as a wedge between the two carinal margins of the two carinal latera.

The *upper latus* is triangular, and has the shape of the sector of a circle, with a somewhat produced apex, however; its scutal margin is slightly hollowed out, its tergal margin is slightly convex.

The *rostrum* is very small and totally hidden under the chitinous membrane. Its exact shape I cannot describe, as I have not isolated it, and as the lateral parts are covered by the rostral latera.

The *rostral latus* has the umbo at the rostral extremity; here the apices of the two valves meet one another in front of the rostrum. The valve is short but broad, distinctly convex, divided by a ridge starting from the umbo.

The *infra-median latus* is triangular, with the umbo at the apex, which projects considerably beyond the surface of the other valves.

The *carinal latus* is of a very irregular shape, with the umbo strongly recurved and projecting beyond the surface of the valves, and slightly also beyond the line of the carina. The carinal margin is almost straight, those of the two valves meet at their base and at the same time at the base of the carina. A ledge starts from the umbo and divides the valve into two parts; the one is flat and situated at the base of the upper latus, the other is curved and divided by a second ledge again into two parts, the greater one being situated between the base and the carinal margin of the valve. This latter part is of a triangular form.

Length of the capitulum, about 43 mm.

The *peduncle* measures nearly 20 mm.; its surface is furnished with not very numerous

but much projecting scales, placed in rather irregular longitudinal and transverse rows.

Of the internal structure of the hermaphrodite (female) specimen I am not able to give details. Complemental males are present in numerous specimens, and are of different sizes. They are found attached at the ordinary place, and among them I found one which was still quite in the pupa-stage. I have figured (Pl. IX. fig. 10) one of the males, which had the largest size of all, and which may be safely considered as a full-grown (ripe) male. Its shape is elongate-triangular, its length 1·5 mm. The body is surrounded by a double wall; the outermost one represents the mantle, the interior one the true body-wall. The exterior one has anteriorly a slit; in that part of the body-wall which lies under this slit the male genital organs open. All the specimens have the two angles at the extremity of the shortest side of the triangle produced into conical excrescences, and a globular excrescence may be seen, moreover, between the two conical excrescences in the middle of the shortest side. The whole surface is covered by minute hair-like spines, much longer ones being present at the surface of the conical excrescences. The anterior half of the body, where the slit is present, has the spines of a very curious shape, as figured in fig. 10; each spine is triangular, the shortest edge being deeply cut in, hence each spine is furnished with numerous (three to seven) points. At the surface of each male is attached, moreover, a long and thin chitinous thread, which perhaps serves for the attachment to the scutum of the hermaphrodite specimen. Of the internal organs the male genital apparatus seems to be the only one which is left; it consists in the full-grown specimen of a rather voluminous testis, of a vas deferens, and of a receptaculum seminis. The latter opens with a short duct by the genital pore.

This species was taken at Station 135, October 18, 1873; off Tristan da Cunha; depth, 1000 fathoms; bottom, rock.

Observations.—The specimen was found attached to a piece of pumice-stone. At about the same place two other species of the genus (*Scalpellum elongatum* and *Scalpellum carinatum*) were taken.

Scalpellum gigas, n. sp. (Pl. IV. figs. 1, 2; Pl. IX. fig. 11).

Surface of the valves covered by a thin chitinous membrane, which is not villous. Valves fourteen. Carina simply bowed, rather massive, with the umbo at the apex, and a laterally slightly convex roof and two flat sides forming a slightly obtuse angle with the roof. Upper latus quadrangular. Carinal latus very high. Peduncle about half as long as the capitulum.

This species is no doubt very nearly related to *Scalpellum darwinii*, and I was long in doubt as to whether I should regard them as distinct or not. The smoothness

of the membrane covering the valves, the different shape of the carinal latera, the shortness of the peduncle, and finally, the totally different form of the complemental males, have forced me to describe and regard them as different.

Capitulum consists of fourteen valves, and is very flat. The membrane which covers the valves is thin, and permits the margins of the valves to be clearly seen; it is furnished with microscopic spines only. The upper parts of most of the valves are not covered by membrane.

Scutum broad, about once and a half as long as broad, convex, quadrilateral, with the occludent margin slightly arched; tergal margin hardly hollowed out, lateral margin almost straight, basal margin straight also; the angle where the lateral and basal margins meet is truncated for the reception of the apex of the infra-median latus. The umbo is at the apex, which slightly projects over the tergum.

Tergum long-oval, the area it covers is about equal to that covered by the scutum. A considerable part of the apex projects freely; it is truncated, having been broken off. The occludent margin is straight, the carinal margin arched, a little stronger than the scutal margin. Basal angle pointed.

Carina simply bowed, with the roof not quite flat, though flatter than in *Scalpellum darwinii*. Roof narrow at the upper end and gradually increasing downwards. Sides making with the roof an angle a little greater than 90°, showing almost the same breadth at the lower end as close to the apex.

Upper latus with a distinct though short carinal margin, hence quadrilateral. Basal margin arched.

Rostrum small, triangular, with the apex high up between the rostral sides of the rostral latera.

Rostral latus trapeziform, with the scutal margin parallel to the basal margin; the rostral angle not projecting beyond the scutum.

Infra-median latus triangular, with nearly equal sides and a long basal margin.

Carinal latus with the apex slightly recurved, triangular; with the upper margin hollowed out, and with the carinal margin distinctly convex. The basal margin is short, and forms an angle with the lateral margin. The basal part of the carina is triangular, and placed between the two carinal margins of the two carinal latera.

Lines of growth of all the valves as in *Scalpellum darwinii;* they may be seen in the figure.

Length of the capitulum, about 40 mm.

Peduncle little more than half as long as the capitulum (23 mm.), in both specimens of an irregular shape, caused by an excrescence in the largest specimen at the carinal side, and in the other specimens situated more laterally. In the upper part the transversely elongated scales are totally covered by membrane; in the lower part, however, they are distinct.

Of this species two specimens have been collected. The measurements of the one have been already given, the length of the other specimen was only 27 mm. for the capitulum and 12 mm. for the peduncle.

I have not studied the internal structure of this animal, but of the complemental males I may give the following description. I got three of them, which I found attached between the mantle and the left hand scutum, at a small distance from the apex. They are globular and rather small; their length is about 1 mm. They are covered by a mantle, which shows a very large slit, and which in the hindermost part of the body is confluent with the wall of the body. This hindermost part forms a globular excrescence, and causes the little male to look as furnished with a rudimentary peduncle. As rudiments of the prehensile antennæ, however, are present at the other extremity of the body, I think this comparison hardly admissible. The interior of the male is yet in an embryonic condition; a rather voluminous testis is present, but it is only just beginning to form spermatozoa, and the receptaculum seminis is still very small. The contents of the body for the rest consist of clear drops and of fatty corpuscles, which probably represent the remains of the deutoplasm of the embryo. The surface of the mantle is covered with microscopic spines, and the inner surface is beautifully striated.

This species was taken at Station 246, July 2, 1875; lat. 36° 10′ N., long. 178° 0′ E.; depth, 2050 fathoms; bottom temperature, 1°·3 C.; bottom, grey ooze.

Observations.—This is one of those cases (referred to already p. 28) in which a species was taken at a considerable distance from the shore, the Station, 246, being situated almost in the middle of the Pacific Ocean.

Scalpellum moluccanum, n. sp. (Pl. V. figs. 3, 4).

Valves fourteen. Surface of the valves covered by a chitinous and almost smooth membrane. Carina simply—not strongly—bowed, with the apex projecting freely, and the roof not flat. Umbo of the carina at the apex. Upper latus almost triangular. Peduncle middle-sized.

This species much resembles *Scalpellum regium* (Wyv. Thoms.), n. sp., and is also nearly related to *Scalpellum velutinum*, n. sp. It is represented by a single specimen only, and as this is not in all respects a sound one, I have been long uncertain whether I should describe it as a distinct species or not.

The *capitulum* consists of fourteen valves; the relative straightness of the carina gives the capitulum an oblong quadrangular appearance. The apex of the scutum projects freely as well as that of the carina. The capitulum is rather stout, and, especially towards the lower end, it is very thick. The valves are covered by a not very thick chitinous membrane, which

leaves the apices of the different valves uncovered, and is sparsely hairy. The scutum is rather more hairy towards the occludent margin. The lines of growth are not very distinct.

The *scutum* has the umbo at the apex, and has the shape of a trapezium, the occludent margin being the longer of the two nearly parallel sides. The apex of the valve is broken, but would have projected freely when present. The valve is, especially on the under side, distinctly convex. The lines of growth are not very distinct, and run partly parallel to the basal margin, partly to the lateral margin. The occludent margin is straight, the tergal margin hollowed out, the lateral margin is convex, the basal margin straight.

The *tergum* is large, having a greater area than the scutum; oval, with the upper angle broken off and therefore truncated, and the under extremity pointed and extending far down between the upper latus and the carina. The occludent margin is straight, the apex broken off and thus truncated; the carinal margin is distinctly arched, the scutal margin is arched as far as it runs at the side of the scutum, and slightly hollowed out near the upper latus.

The *carina* is simply but slightly bowed; from the apex to the basis it widens considerably. It has a distinct roof, which is not quite flat but slightly convex; the sides of the carina are at angles greater than 90° with the roof. The apex projects freely, but being broken it is impossible to judge of the extent of this free projection.

The *upper latus* is quadrangular, owing to the shortness of the carinal margin almost triangular, with the umbo at the apex, slightly but distinctly beaked, and projecting over the surface. The scutal margin is almost straight, only slightly hollowed out; the tergal margin is distinctly arched, the basal margin slightly convex.

The *rostrum* is almost totally covered by the chitinous membrane; it is very small and carinate; the lateral parts are covered by the rostral latera.

The *rostral latus* is broad but low, trapeziform, with the umbo at the rostral extremity. The basal margin is shorter than the scutal margin.

The *infra-median latus* is not very small, and of a triangular shape.

The *carinal latus* is medium-sized, and has the same shape almost as in *Scalpellum regium*, *Scalpellum darwinii*, and *Scalpellum velutinum*. The umbo is seated at the apex, which is beaked and slightly projecting outwards. A ledge arises from the apex, and separates a small oval depression from the upper latus. The carinal margins of the two carinal latera are convex, and touch each other at the base and below the middle of the carina.

Length of the capitulum about 33 mm., of the peduncle 16 mm.

The *peduncle* is stout, growing only slightly thinner towards the under extremity. The scales are placed in about nine longitudinal rows, and are totally covered by membrane. Transversely each row consists of eight scales.

No complemental males observed.

This species was taken at Station 195, October 3, 1874; lat. 4° 21′ S., long. 129° 7′ E.; depth, 1425 fathoms; bottom temperature, 3°·0 C.; bottom, grey ooze.

Observations.—It is extremely difficult to decide whether one is right in considering the specimen taken at Station 195 as specifically distinct from *Scalpellum regium*. After long hesitation, I have decided to do so, in the first place, because the capitulum as a whole has a more elongate shape; in the second place, because the chitinous membrane which covers the valves of *Scalpellum moluccanum* is smooth or almost smooth, whereas in most specimens of *Scalpellum regium* it is distinctly hairy. In the third place, the form of the upper latus is different, being a great deal broader in *Scalpellum regium* than in the present specimen. As in other similar cases, these differences may turn out—by intermediate forms being discovered—not to be of enough importance for creating different species. In that case our *Scalpellum moluccanum* will retain the significance of a so-called local variety.

Scalpellum regium (Wyv. Thoms.), n. sp. (Pl. IV. figs. 3–5; Pl. IX. fig. 12; Pl. X. figs. 1, 2).

Surface of the capitulum covered by membrane, which in some specimens is rather smooth, in others hairy. Valves fourteen. Carina simply bowed, with the roof laterally convex. Umbo of the carina at the apex. Upper latus quadrangular. Peduncle short. Complemental males numerous.

This is one of the largest species known. It is represented by numerous specimens, and was found at two different stations, which, however, are close to one another and have almost the same depth. This depth almost reaches 3000 fathoms. The different bottles containing this species are labelled *Scalpellum regium*, n. sp., or *Scalpellum regium*, Wyv. Thomson. Though no sufficient description of this species has been published, I retain the name given to it by the chief of the scientific staff on board the Challenger, the late Prof. Sir C. Wyville Thomson.[1] This name has been mentioned in another printed publication, viz., in a paper of M. Al. Humbert, inserted in the Journal de Zoologie, iii., 1874, p. 133. No doubt M. Humbert found the name in one of the letters sent by Dr. v. Willemoes Suhm to Prof. v. Siebold, and published in the Zeitschr. f. Wissensch. Zoologie, or else in the Reports from the Challenger.[2]

Capitulum with fourteen valves, which are covered by membrane, which in some of the specimens is almost entirely smooth, in others, however (and especially in the older specimens), it is rather hairy. The capitulum is very robust, almost quadrangular; very thick near the peduncle, and flatter towards the apex. The valves have their umbones at the apex, and show very distinct lines of growth. Tergum, scutum, and upper latus are very large; the valves of the lower whorl comparatively small.

Scutum trapeziform, only one and a third as long as broad. Convex, with the

[1] *Nature*, 1873, vol. viii. p. 347. Thomson, C. Wyv., Voyage of the Challenger, Atlantic, vol. ii. p. 4.

[2] *Proc. Roy. Soc.*, vol. xxiv., No. 170, p. 574.

occludent margin almost straight, the basal margin straight, the lateral margin slightly convex, and the tergal margin hollowed out. The umbo is at the apex, which in younger specimens is produced and pointed, in older ones broken off, hence blunt.

Tergum very large, triangular. The scutal margin is almost straight, only slightly convex; the occludent margin is straight, the angle which it describes with the scutal margin is a little greater than 90°. The third margin of the triangle is the carinal margin, which is very convex. It adjoins the carina for a little more than half its length; a considerable part therefore extends above the apex of the carina. In all the larger specimens the apex of the valve is broken off.

Carina very robust, with the umbo at the apex, which does not penetrate between the two terga. The carina is considerably bowed, and increases much in width from the apex to the undermost part. The roof is not quite flat but laterally rather convex. The sides of the valve are not much developed, and are about at right angles with the roof. The lower extremity of the valve is triangular, and penetrates between the two carinal margins of the carinal latus.

Upper latus large, quadrangular, with the scutal and tergal margins almost of the same length, and the carinal and basal margins also nearly equal. The umbo is at the apex.

Rostrum very small; it is separated from the opening between the two scuta by the umbones of the rostral latera. The shape of the rostrum is nearly oval.

Rostral latus broad but rather low; it has the shape of a trapezium, the basal and scutal margins being the two parallel ones. A ridge starting from the umbo divides the valve into two triangular parts.

Infra-median latus triangular, with the umbo at the superior extremity.

Carinal latus of a rather irregular shape, and much resembles that of *Scalpellum gigas*. The umbo is at the apex, which is beaked and distinctly recurved. The upper margin is hollowed out, the carinal margin convex. A rather prominent ridge is given off from the apex, and divides the valves into two triangular parts; of these one is a distinct latus, the other belongs rather to the carinal side of the capitulum. The latter part is divided into two parts by a less prominent ridge, which divides that half into two unequal parts, the narrower being the one which is separated from the carina by the carinal margin. In the full-grown specimens the carinal margins of the carinal latera meet each other at the base of the carina; in the younger they seem to be separated from each other by a narrow and uncalcified or incompletely calcified part, which probably represents a sub-carina.

Length of the capitulum 37 mm., breadth 26 mm.

Peduncle rather short (22 mm.), cylindrical, robust; covered by membrane. Scales numerous in the superior part, totally covered by the membrane; in the inferior part only their edges are distinctly visible. Scales placed in numerous (eleven) longitudinal

rows, each row containing about sixteen scales. Surface of peduncle furnished with very long and delicate bristles.

Mouth.—(Pl. X. fig. 1), *Labrum* bullate, with an anteriorly projecting and rather flat part. *Palpi* robust, with very numerous hairs at the extremity and on the outer surface; their shape resembles that of the last joint of the human thumb. *Mandibles* with three teeth, nearly equal, the first being only slightly longer than the two following ones. The inferior angle broad, rounded at the extremity, which is flat and indistinctly pectinated. The outer surface of the inferior angle is furnished with very delicate hairs. *Maxillæ* elongate, not very narrow. Free edge (Pl. X. fig. 2) without any notch; however, neither straight, being slightly excavated in the superior and slightly convex in the inferior half. The free edge is beset with a double row of strong spines; the superior angle shows only one great spine. It is much thicker but only slightly longer than the other spines. *Second maxillæ* with a rounded lobe at the anterior margin furnished with numerous hairs. The hindermost part of the outer surface over almost the whole length is also furnished with very long and slender hairs or bristles. Orifice of the so-called olfactory organ not placed on a long tubular process.

Cirri.—First pair with the rami unequal; the most anterior one has eight broader the posterior ramus twelve narrower, segments. The second pair has also unequal rami; one of twenty-one, and one of twenty-four segments. The other cirri have equal rami. The caudal appendages are relatively large, four-jointed, and furnished with a tuft of very long hairs at the extremity. There are also rows of very long hairs on the anterior margins of the other segments.

Penis wanting.

Eggs large (greatest diameter 1·03 mm., shortest 0·87 mm.); united in two flat masses, each of which contains two layers of ova. Number of eggs in each packet about 200.

Complemental males numerous. They have a long cylindrical shape, and are of a very simple structure (Pl. IX. fig. 12). In one of the full-grown specimens those of the one side numbered about half a dozen, those of the other side four. I have been able to study their anatomy by transverse sections. Details will be given in the third part of the present report. The length of the males is about 1·7 mm. They are covered by a mantle densely beset with very numerous spines. At the one side this mantle has a slit through which the rudimentary antennæ peep out. The opening of the genital apparatus is at the other extremity of the little animal. The structure of the genital apparatus shows the same parts as in the complemental males of the other species,—testis, receptaculum seminis, vas deferens.

Scalpellum regium (Wyv. Thoms.), n. sp., was dredged at two Stations. Station 61, June 17, 1873; lat. 34° 54′ N., long. 56° 38′ W.; depth, 2850 fathoms; bottom temperature, 1°·5 C.; bottom, grey ooze. Station 63, June 19, 1873; lat. 35° 29′ N., long. 50° 53′ W.; depth, 2750 fathoms; bottom, grey ooze.

Observations.—This species seems to be rather common at very great depths in the Atlantic Ocean. As far as known at present, these are the deepest places inhabited by Cirripedia. As well by the structure of the female (and hermaphrodite?) as by that of the male specimen, the species closely resembles other species living at a considerable depth, and also some from much lesser depths. The deep-sea species, as a true typical specimen of which the present form must be regarded, have no distinct character of their own. The very rudimentary condition of their complemental males is observed in some of the shallow-water species also.

Scalpellum regium, var. *ovale* (Pl. V. figs. 5, 6).

Together with six specimens of *Scalpellum regium*, a specimen was dredged, which in most respects resembles the typical species, but which differs from it in general shape and in the length of the peduncle. Its capitulum is not quadrangular but long-oval, and this is caused by the greater length of the carina, the apex of which is situated at a small distance from the apex of the tergum. The tergum itself is a great deal smaller, and has about the same area as the scutum. The carina has the sides almost undeveloped. Of the valves of the lower whorl, the rostrum is small and very narrow; the rostral latus and the infra-median latus much resemble those of *Scalpellum regium*. The carinal latus, however, is a great deal larger; higher in the first place. Moreover, the ridges which divide the same valve in *Scalpellum regium* into distinct triangles are by no means so distinct in the variety. At the carinal side the two valves are separated by a membranous part, which probably represents the sub-carina.

The length of the capitulum in the only specimen is 31 mm., whereas the peduncle measures 22 mm. The capitulum is covered by membrane, but even when studied with a lens this membrane appears smooth, that is, not hairy as in the typical specimens. The peduncle has an irregular cylindrical shape; the scales are distinct in the inferior part of the peduncle, but totally covered by membrane near the capitulum. There are about eleven longitudinal rows, some of which number on less than twenty scales.

This variety was furnished with a complemental male, which was still in the pupa-stage. This, however, is no reason, I think, why we should consider the specimen as a young specimen of *Scalpellum regium;* for, in the first place, I often observed males in that condition attached to the same female together with well-developed males, and in the second place, because one of the specimens of *Scalpellum regium*, the capitulum of which measured only 25·5 mm., was furnished with as many as four well-developed males.

The animal was taken at Station 61, June 17, 1873; lat. 34° 54′ N., long. 56° 38′ W.; depth, 2850 fathoms; bottom temperature, 1°·5 C.; bottom, grey ooze.

Scalpellum darwinii, n. sp. (Pl. V. figs. 1, 2; Pl. X. figs. 3–5).

Surface and borders of the valves almost hidden under a thick villous membrane. Valves fourteen. Carina simply bowed, massive, considerably increasing in width from the upper to the lower part; with the umbo at the apex, and with the roof convex and gradually passing into the sides. Upper latus having the form of the sector of a circle of about 50°. Peduncle rather long. Males four.

This is the largest species of *Scalpellum* known. Only a single specimen of it was dredged during the cruise of the Challenger.

Capitulum consisting of thirteen valves, the carina being the only single one. Valves covered by a brownish and very thick membrane, which, however, on the carina, tergum, scutum, and upper lateral valve, diminishes in thickness from the lower to the upper end, the latter in consequence being marked out by a lighter colour.

Scutum broad, not quite twice as long as broad, convex, quadrilateral, with the occludent margin the longest; tergal margin slightly hollowed out, lateral margin slightly convex. The umbo is at the uppermost point of the valve; the lines of growth run parallel with the basal and lateral margins. The apex does not project over the tergum.

Tergum large, having a greater area than the scutum; flat, oval, with the apex truncated (having been broken off), and the basal angle pointed. The occludent margin is straight, the carinal margin distinctly arched, the scutal margin being arched also, but not so distinctly. Lines of growth not very distinct.

Carina simply bowed, boat-shaped, with a rounded keel. Very broad near the lower extremity, gradually growing narrower towards the upper end. Sides nearly as broad at the lower end of the valve as close to the apex. Lines of growth oblique, meeting in the median line.

Upper latus triangular, large, with the apex pointed, the umbo being near the apex. The side which is opposed to the apex, and which is composed of the carinal and the basal margins, describes a beautiful curved line.

Rostrum represented by an extremely small and very narrow valve between the rostral angles of the rostral latera. Totally hidden under the chitinous membrane.

Rostral latus trapeziform, with the scutal margin almost parallel to the basal margin; the rostral angle slightly projects beyond the scutum.

Infra-median latus triangular, with nearly equal sides and a long basal margin.

Carinal latus large, of an irregular shape, subtriangular, umbo projecting outwards, the apex being distinctly beaked. A ledge starting from the apex describes a curve, and separates a small depression from the basal margin of the upper latus. The carinal margin is slightly convex, the triangular basal part of the carina being placed

between the carinal margin of the two carinal latera. Lower margin considerably convex; upper margin slightly concave.

Length of capitulum, about 46 mm.

Peduncle long (31 mm.), stout, growing wider towards the upper end, though even here by no means attaining the width of the capitulum. Whereas the capitulum is, especially in the upper part, much flattened, the peduncle is circular in section. The peduncle is also covered by membrane; the transversely elongated scales therefore not very distinct, a little more so in the lower part of the peduncle.

The accompanying woodcut (fig. 3) shows the way in which the only specimen of this species was attached to a manganese nodule. These nodules, Mr. Murray informs me, are formed by concretionary depositions around sharks' teeth, pumice, and other substances at the bottom.

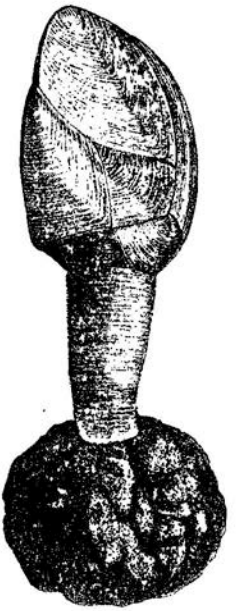

FIG. 3.—*Scalpellum darwinii*, attached to a nodule of manganese.

I have not studied the structure of the animal contained within the valves. I found four complemental males attached between the mantle and the scutum, at a short distance from the apex of the valve and close to its occludent margin. Three specimens were on the left and one on the right side. They have the same shape as those of *Scalpellum regium*, but they are considerably larger, having a length of 2·7 mm. Small prehensile antennæ indicate the anterior extremity of the body, the opening of the genital duct being at the other extremity. The great size of the males enabled me to make preparations of their anatomy; with the aid of which the figures on Pl. X. are drawn. The wall of the body is distinctly seen under that which represents the mantle; muscles are attached to the former, and the latter is covered by very minute bristles.

This species was taken at Station 299, December 14, 1875; lat. 33° 31′ S., long. 74° 43′ W.; depth, 2160 fathoms; bottom temperature, 1°·1 C.; bottom, grey mud.

(B.) Species without a Rostrum.

Scalpellum distinctum, n. sp. (Pl. VI. figs. 10, 11).

Valves thirteen, not covered by membrane, separated from each other by distinct chitinous interspaces. Carina with the umbo at the apex, simply bowed, with a flat roof

furrowed longitudinally. Upper latus large, hexagonal. Infra-median latus large, wine-glass shaped. Scutum almost triangular. Peduncle cylindrical, with minute and very prominent scales.

This species is extremely characteristic through the form of its scutum and of its upper latus. It is represented by a single specimen only.

Capitulum of an elongate-oval shape, flat, consisting of thirteen valves only. The valves show distinct lines of growth, and are separated from each other by rather broad chitinous interspaces.

Scutum triangular, caused by the lateral margin being almost a prolongation of the short basal margin. Occludent margin arched. Tergal margin rather long, a triangular portion is described at the lateral extremity of the tergal margin by this margin, and by the uppermost part of the lateral margin. This triangular portion penetrates between the upper latus and the tergum, where it is received into a small excavation. Umbo of the scutum at the apex, which is slightly turned upwards.

Tergum triangular, with a not very long occludent margin. Carinal margin slightly arched, scutal margin slightly hollowed out. A triangular portion at the basal angle penetrates between the upper latus and the carina.

Carina not very strongly and simply bowed. Roof flat, not increasing much in width from the upper to the lower extremity; bordered by distinct ridges, hence the surface appears longitudinally furrowed. Sides at right angles with the roof, not very wide, but of the same width over the whole length of the carina.

Upper latus irregularly hexagonal, rather large. Its umbo is seated a little above the middle of the scutal margin.

Rostral latus irregularly quadrangular. Scutal margin almost straight, lateral margin describing an S-shaped line, rostral margin straight, basal margin straight also.

Infra-median latus having the form of a wine-glass. The foot is small, triangular, and the umbo is seated at the base of a much larger and wider portion.

Carinal latus irregularly quadrangular. Umbo at the foot of the carinal margin, slightly protuberant beyond the edge of the carina. Carinal margin hollowed out, upper margin short and oblique. Lateral margin hollowed out, basal margin well-developed.

Length of the capitulum, 15·5 mm.

Peduncle short, 5·5 mm., covered by very small and numerous calcareous scales, placed in not very regular rows. On some of the longitudinal rows thirteen or fourteen scales may be distinguished. The scales have very prominent and rounded free edges. The chitin of the peduncle may everywhere be seen between the scales.

Structure of the animal not studied; complemental male not observed.

The species was taken at Station 218, March 1, 1875; lat. 2° 33′ S., long. 144° 4′ E.; depth, 1070 fathoms; bottom temperature, 2°·1 C.; bottom, Globigerina ooze.

Scalpellum minutum, n. sp. (Pl. V. fig. 12).

Valves thirteen, with their surface covered by thin membrane. Valves thin and brittle. Carina simply and not very strongly bowed, with the umbo at the apex. Infra-median latus oblong quadrangular. Upper latus pentagonal.

This very small species is represented by a single specimen only. It comes near to *Scalpellum novæ-zelandiæ*, and belongs to the same division of the genus as that species, and as *Scalpellum flavum*. It may be distinguished from these species by the form of the carina almost at first sight.

The *capitulum* is very flat, the valves are covered by very thin membrane, and do not show distinct ridges of growth.

The *scutum* is elongate, quadrangular, almost twice as long as broad. The umbo is at the apex, which is slightly protuberant beyond the occludent margin of the tergum.

The *tergum* is stout, and surpasses the scutum in area. Its apex is recurved, the occludent margin being slightly arched.

The *carina* is not so long as in *Scalpellum flavum*, and is almost straight. The roof is flat, and does not increase considerably in width from the upper to the lower extremity. The umbo is at the apex, which almost penetrates between the two scuta; the roof shows a small thickened portion near its apical extremity.

The *upper latus* is pentagonal, being truncated at the angle formed by the basal and scutal margins.

The *rostral latus* is triangular; its rostral margin is arched, its scutal margin hollowed out, its lateral margin arched also.

The *infra-median latus* is narrow, being only slightly wider near the upper extremity. It is an impossibility to distinguish the place where the umbo is seated; it is probably close to the base.

The *carinal latus* has an irregular shape. Its carinal margin is hollowed out in the superior portion, and its umbo is situated at a considerable distance from the base. Hence, there is a well-developed inferior portion of the carinal margin also. Lateral and upper margins of the same length and almost straight.

Length of the capitulum, 6 mm.

The *peduncle* is very short, not quite 2 mm. Some very small scales are developed at the upper extremity of the peduncle; they are wanting near the lower extremity.

Structure of the animal within the capitulum not studied; complemental male not observed.

This species was taken at Station 302, December 28, 1875; lat. 42° 43′ S., long. 82° 11′ W.; depth, 1450 fathoms; bottom temperature, 1°·5 C.; bottom, Globigerina ooze.

Observations.—I cannot say with certainty whether the specimen taken at Station

302 is indeed a full-grown one. As in many of the other cases in which I propose a new species for a single specimen, it has only been done because it was an utter impossibility to consider it as a specimen of one of the better established species. Future investigations, conducted upon a richer material, will alone be able to decide this question.

Scalpellum abyssicola, n. sp. (Pl. VI. fig. 12).

Surface of the valves covered by a very thin membrane, almost smooth. Valves thirteen; they are thin and brittle. Umbo of the carina at the apex. Carina simply but strongly bowed, with the roof flat. Upper latus hexagonal, very large. Infra-median latus oblong, quadrangular.

This species is represented by a single specimen only. It is a small and rather elongate species, in many respects resembling *Scalpellum novæ-zelandiæ*, *Scalpellum flavum*, &c.

Capitulum elongate, surface unequal, a distinct gibbosity being observed near the middle of the upper latus. The occludent margin is very slightly arched, the carinal margin much more distinctly. Valves thirteen; the chitinous membrane which covers their surface is very thin.

Scutum quadrilateral, elongate, large. Occludent margin slightly convex, tergal margin a little hollowed out, apex—where the umbo is—slightly projecting over the tergum. Lateral margin hollowed out at the superior extremity and slightly convex in the inferior part. Basal margin slightly convex also.

Tergum elongate, triangular. Occludent margin slightly convex, scutal margin slightly hollowed out, carinal margin again convex.

Carina elongate, with a flat roof regularly though not very strongly increasing in width from the upper to the lower extremity. Sides well-developed, but more so in the upper than in the lower half of the valve. The sides are about at right angles with the roof. Umbo of the valve at the apex.

Upper latus rather large. Tergal and carinal margins almost straight, basal margin consisting of two parts,—a larger and slightly arched one separating it from the carinal latus, and a smaller straight one against which the infra-median latus is placed. The scutal margin follows the margin of the scutum, against which it is placed.

Rostral latus, as the other latera of the lower whorl, rather high. Caused by the shortness of the basal margin, the shape of the valve is nearly triangular. The rostral margin is straight, and placed against the same margin of the valve of the other side; the scutal margin is slightly hollowed out, the lateral margin is again slightly convex.

Infra-median latus hour-glass-shaped, with the umbo about in the middle of the valve. The basal margin is only a little broader than the upper margin.

Carinal latus large, penetrating with its upper part between the carina and the upper latus. Lateral margin convex, carinal margin hollowed out in the uppermost portion, the inferior portion being nearly straight, basal margin as long as the inferior portion of the carinal margin.

Length of the capitulum, 8 mm.

Peduncle short, about one-third the length of the capitulum. Totally covered by scales, which are placed on very regular longitudinal rows. Each of these rows, of which there are about seven, contains eight scales.

I have not been able to study the structure of the animal within the capitulum, nor have I observed the complemental male.

The species was taken at Station 246, July 2, 1875; lat. 36° 10′ N., long. 178° 0′ E.; depth, 2050 fathoms; bottom temperature, 1°·3 C.; bottom, grey ooze.

Scalpellum vitreum, n. sp. (Pl. V. fig. 14).

Surface of the valves smooth, not covered by membrane, beautifully striated. Valves thirteen. Carina simply, only slightly, bowed, with the roof flat. Umbo of the carina at the apex. Upper latus trapeziform. Infra-median latus small, triangular. Other valves of the lower whorl well-developed. Peduncle short.

This species is represented by a single specimen only. It is medium-sized, and belongs to the species with the valves of the lower whorl well-developed.

The *capitulum* is elongate, not quite twice as long as broad, very flat, and consisting of thirteen valves only. The surface of the valves is not covered by membrane, therefore smooth. The smoothness, however, is incomplete, as the valves are furnished with parallel and very delicate ridges, which are in a perpendicular or in a somewhat oblique direction to the lines of growth. The lines of growth are only very imperfectly visible.

The *scutum* is quadrilateral, with the occludent margin convex, the basal margin slightly hollowed out, the lateral margin straight, and the tergal margin straight also, and only slightly hollowed out in the anterior part. The umbo is at the apex, which is a little produced, and projects over the tergum.

The *tergum* nearly equals the scutum in size, its occludent margin is convex, the two other margins are nearly straight; the carinal margin is considerably longer than the scutal margin.

The *carina* is long and has a flat roof. At its inferior extremity this roof has a considerable width, which slopes towards the apex, where the umbo is situated. The sides in the undermost part of the valve are narrow and at right angles with the roof; in the superior part, however, they are broader, and at angles greater than 90° with the roof. Here these sides are delicately but very distinctly furrowed.

The *upper latus* is trapeziform, and has the four margins nearly straight. The scutal margin is the longest, the carinal margin the shortest of the four, the tergal and basal margins are almost of equal length.

The *rostral latus* is almost triangular, the lateral margin being almost the prolongation of the short basal margin. The umbo is at the extremity of the occludent margin of the scutum. The valve is indistinctly divided into two parts, by a ridge running from the umbo to the point where the lateral and basal margins meet.

The *infra-median latus* is triangular and rather narrow, and has the umbo at the superior extremity. This superior extremity does not reach the scutal-basal angle of the upper latus.

The *carinal latus* is large and almost trapeziform. The lateral and upper margins are almost of the same length, and the basal margin is only a little shorter. The carinal margin, on the contrary, is a great deal longer. It has the umbo at one-fourth of the total length from the inferior extremity. The part above the umbo is slightly excavated.

Length of the capitulum, 13·5 mm.

The *peduncle* is extremely short (3·5 mm.), conical, furnished with a membrane which covers the scales also. Hence these are only imperfectly visible. They form seven longitudinal rows, each of them composed of about eight rather large scales.

I have not studied the animal contained within the capitulum of this species, and complemental males were not present at the place they ordinarily occupy.

This species was taken at a small distance from Yeddo, at Station 237, June 17, 1875; lat. 34° 37′ N., long. 140° 32′ E.; depth, 1875 fathoms; bottom temperature, 1°·7 C.; bottom, mud.

Observations.—This species is nearly related to *Scalpellum truncatum*, *Scalpellum australicum*, &c. The form and structure of the valves, however, show its distinctness.

Scalpellum planum, n. sp. (Pl. IV. figs. 12, 13).

Surface of the capitulum smooth, covered by a very thin membrane. Valves thirteen. Scutum triangular. Carina simply bowed, with a flat roof and the umbo at the apex. Upper latus large, with the umbo near the middle of the scutal margin. Infra-median latus narrow, elongate.

This elegant little deep-sea species is represented by a single specimen.

The *capitulum* is elongated and very flat. Its greatest breadth is about in the middle, towards the peduncle it is a great deal narrower. The margins of the valves are very distinct. The carina is separated from the tergum by an interspace filled with chitinous membrane.

The *scutum* is almost triangular, the basal and lateral margins forming almost a continuation of each other. The occludent margin is slightly arched, the tergal margin is straight, the lateral and basal margins form together an undulating line. The umbo is at the apex.

The *tergum* is large, with the occludent margin convex, the scutal margin slightly hollowed out, and the carinal margin slightly convex in the undermost, and hollowed out in the uppermost, part. The umbo is at the apex, which is distinctly recurved.

The *carina* is simply bowed, with the roof flat. The roof only slightly increases in width from the apex towards the base, and is bordered on each side by a distinct ridge. The valve is furnished with distinct lateral parts, which are at right angles with the roof, and increase much in width from the base upwards.

The *upper latus* has a very characteristic shape, with the umbo seated about in the middle of the scutal margin. It has about the shape of the greatest half of a pentagon, and it is limited by five sides; the longest is the scutal margin, then follows the carinal margin, then the margin between this valve and the carinal latus, then the tergal margin, and finally comes the shortest of all, viz., the margin between it and the rostral latus. The third and fifth together form the basal margin of the valve.

Of the valves of the lower whorl, the rostral and carinal latera, though not very wide, are well-developed; the infra-median latus, however, is extremely narrow.

The two *rostral latera* meet one another below the occludent margin of the scuta, with long rostral margins. The umbo is at the apex, and projects distinctly over the edge of the scutum. Each rostral latus is divided into two triangular parts by a ridge running from the apex to the hindermost edge of the basal margin.

The *infra-median latus* is extremely narrow; its umbo is seated at a small distance from the apex, and projects a little over the surface of the valve. The valve slightly increases in width from the apex to the base.

The *carinal latus* is pentagonal. Its umbo is at the base of the carina, and projects distinctly over the hinder margin of the carina. The valve is divided into three triangles by two ridges starting from the umbo. Of these triangles the uppermost is by far the greatest. The carinal margin is divided into two parts, one above the umbo hollowed out and longer, the other beneath the umbo short and nearly straight.

Length of the capitulum, 12 mm.

The *peduncle* is short, 3 mm. only, and totally covered by calcareous scales. Of these about eleven are placed in a longitudinal row, the number of these rows being also about eleven. As a prolongation of the peduncle a chitinous membrane covers a part of the horny thread by which the specimen is attached, and this membrane presents also some small calcareous scales.

The structure of the animal contained within the capitulum has not been investigated, nor have I been able to make out whether complemental males were present or not. In

this and in other cases where the object is small and only a single specimen is present, the fear of spoiling the specimen made me unwilling to dissect it.

This species occurred at Station 160, March 13, 1874; lat. 42° 42′ S., long. 134° 10′ E.; depth, 2600 fathoms; bottom temperature, 0°·2 C.; bottom, red clay.

Observations.—This species shows much resemblance to *Scalpellum distinctum*, dredged from a depth of 1070 fathoms in the Pacific Ocean north of New Guinea. The different shape of the valves of the lower whorl, and also of the scutum, has made me consider them as different species. The difference in depth is also considerable, but this alone would by no means be of sufficient importance to separate the species.

Scalpellum australicum, n. sp. (Pl. V. fig. 11).

Surface of the valves naked, with slightly prominent ridges. Valves thirteen, closely locked together. Carina with the umbo at the apex, simply bowed, with the roof flat and bordered on each side by a rather prominent ridge. Upper latus trapeziform. Infra-median latus narrow, elongate. Umbo of the carinal latus projecting beyond the carina.

Of this species only a single specimen was collected; from the same locality a specimen of *Scalpellum dubium*, and one of *Scalpellum truncatum* were obtained.

Capitulum flat, consisting of thirteen valves. Valves naked, with distinct ridges and furrows. There are no distinct interspaces between the different valves. The shape of the capitulum is elongate-oval.

Scutum slightly convex, with the occludent margin arched; the tergal margin is feebly undulating, being hollowed out near the apex and convex towards the lateral margin. The umbo is at the apex, which projects over the tergum; the lateral margin is very irregular, the umbo of the upper latus projecting a great deal over the scutum. The basal margin is rather short, straight, and at an angle less than 90° with the occludent margin.

Tergum triangular, with the occludent margin arched, the carinal margin undulating, and the scutal margin rather irregular. The umbo is at the apex, which is distinctly recurved.

Carina simply bowed, with the roof flat and bordered by distinct ridges; sides at about right angles with the roof, and much broader near the upper extremity of the valve.

Upper latus trapeziform, with the apex, where the umbo is seated, projecting very much over the scutum. Carinal margin short, scutal margin hollowed out, basal-scutal angle truncated.

Rostral latus irregularly quadrangular. Lateral margin straight and rather long, scutal margin hollowed out, basal margin short. The umbo is at the rostral upper angle of the valve, and projects over the occludent margin; from the umbo a curved

ridge runs towards the posterior basal angle. This ridge divides the valve into a larger lateral and a smaller rostral part.

Infra-median latus extremely narrow, with the umbo near the base; the part above the umbo is comparatively large and wedge-shaped, the part below the umbo is small and triangular.

Carinal latus quadrangular, with the umbo projecting considerably beyond the carina. The carinal margin is hollowed out, the upper and lateral margins are straight. The basal margin is rather long, the lowest parts of the carinal margins of the two carinal latera touch one another under the middle of the carina. From the umbo a curved ridge runs to the anterior basal angle of the valve.

Length of the capitulum, 12·5 mm.

Peduncle slightly conical, being a little wider near the capitulum than near the base. It is very short (little more than 2 mm. long). The scales are prominent and not numerous, each longitudinal row contains no more than seven, and there are five of these rows. The scales near the capitulum are distinctly larger than those near the base of the peduncle.

Of this beautiful little species I have not studied the internal structure of the animal, nor have I been able to observe the complemental male.

The species was dredged at Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; depth, 1400 fathoms; bottom temperature, 1°·8 C.; bottom, grey ooze.

Observations.—*Scalpellum australicum* is nearly related to *Scalpellum antarcticum*, *Scalpellum tenue*, and some other species. Future investigators examining a great number of specimens, will perhaps only regard as varieties what I believe to be distinct species.

Scalpellum tenue, n. sp. (Pl. IV. figs. 20, 21; Pl. X. fig. 6).

Valves thirteen, covered by a thin woolly membrane. Carina, with the umbo at the apex, simply and feebly bowed, with the roof flat. Upper latus trapeziform. Infra-median latus narrow, small. Umbo of the carinal latus not projecting beyond the carina. Peduncle cylindrical, short.

This species is represented by a single specimen only; in general shape it much resembles *Scalpellum antarcticum*. On closer examination it appears to be distinct.

Capitulum consists of thirteen valves; there is a trace of a rostrum, but it is too rudimentary to be considered as a distinct valve. The valves are covered by a thin woolly membrane; the lines of growth can only be followed indistinctly under that membrane. In general outline the valve is elongate-oval; at its base it is sharply marked off from the peduncle.

Scutum about twice as long as broad. Occludent and lateral margins nearly parallel;

umbo at the apex, which is produced and slightly recurved; it projects a little over the tergum.

Tergum triangular, stout, broad. Occludent margin long, arched. Apex recurved. Scutal margin almost straight, carinal margin straight in the under, hollowed out in the upper, part.

Carina very large, simply bowed, but almost straight. Roof flat, not bordered by distinct ridges. Sides of the valves at angles with the roof greater than 90°. These sides are broader near the upper extremity than near the lower end.

Upper latus quadrangular; the angle described by the scutal and basal margins truncated; hence the valve appears to be pentagonal. The apex slightly projects over the scutum.

Rostral latus quadrangular; the scutal and basal margins parallel. The valve is divided by a ridge into two triangular parts.

Infra-median latus does not reach the slightly truncated scutal-basal angle of the upper latus; narrow. Umbo at the upper extremity.

Carinal latus quadrangular. Carinal margin almost straight, umbo seated near the base and slightly protuberant; basal, lateral, and upper margins almost straight. Beneath the ridge, which runs from the umbo to the angle between the lateral and basal margins of the valve, only a very small triangular part is situated.

Length of the capitulum, 17 mm.

Peduncle cylindrical, rather narrow. Length of the peduncle, 5·5 mm. Scales almost totally covered by membrane, hence indistinct; their edges only are slightly protuberant beyond the surface of the peduncle.

The structure of the animal contained within the valve has not been studied by me. With regard to the complemental males of this species, the following may find a place here (Pl. X. fig. 6). At the interior of each scutum there is found one attached close to the occludent margin, between the adductor muscle and the tergal margin. The length of these complemental males is 1·1 mm., their breadth about 0·7 mm.; so their shape is a broad oval. The mantle which covers them is almost smooth on one side only; where the genital apparatus opens, it is furnished with very short spines. The structure of the interior is very simple; there is a very large heart-shaped testis, which at its pointed extremity communicates by a rather long duct with the receptaculum seminis. From this, as in the other species, a long vas deferens is given off which opens at the posterior extremity of the small body. The male is attached to the interior of the scutum by means of prehensile antennæ. The extremity where the genital apparatus opens forms a globular excrescence, the end of which bears some stronger spines.

Scalpellum tenue was taken at Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; depth, 1375 fathoms; bottom temperature, 1°·5 C.; bottom, Globigerina ooze.

Scalpellum indicum, n. sp. (Pl. VII. fig. 1).

Valves thirteen; covered by a chitinous and villous membrane. Carina simply and very strongly bowed, with the umbo at the apex, and with a flat roof not bordered by ridges. Upper latus quadrangular. Umbo of the carinal latus at the upper extremity of the carinal margin. Peduncle rather short.

Of this interesting little species only a single specimen was taken. It is an inhabitant of shallow water, but it resembles the true deep-sea species both in regard to the form of the carina and the carinal latus.

The *capitulum* is covered by membrane, which causes the margins of the different valves not to be everywhere distinctly visible. This membrane is furnished with short woolly hairs. The shape of the capitulum is elongate, the undermost half of the carinal side runs parallel with the rostral side. The surface on both sides is almost flat. The valves of the lower whorl are small. The rostrum is absent and the total number of the valves is thirteen.

The *scutum* is trapeziform and elongate; its occludent and lateral margins run parallel to each other, and are at right angles to the basal margin. The umbo is at the apex, which is slightly produced. The tergal margin is a little hollowed out, and is shorter than the lateral margin.

The *tergum* is oval, with the apex and the angle formed by the scutal and carinal margins pointed and slightly produced. The occludent margin is almost straight, and forms the continuation of the occludent margin of the scutum.

The *carina* is elongate, simply, rather strongly bowed, with the umbo at the apex. Its roof is flat and is not bordered by distinct ridges, for it passes almost imperceptibly into the very narrow sides of the valve. The breadth of the roof of the carina is not very considerable; its basal portion is triangular, and penetrates between the two carinal margins of the carinal latera.

The *upper latus* is quadrangular, and has the umbo at the apex. The scutal margin is straight, and is the longest of the four. The tergal and basal margins have almost the same length, whereas the first is nearly straight, the second is distinctly convex. The carinal margin is straight also, and a little shorter than the tergal margin.

The *rostral latus* is short but very broad. Its scutal and basal margins run nearly parallel to each other. Its umbo is at the base of the occludent margin of the scutum, where the rostral margins meet one another. The place where the umbo is is slightly protuberant beyond the rostral margin.

The *infra-median latus* is small, triangular. Its umbo is at the apex, which is slightly turned forward.

The *carinal latus* is almost triangular, which is the consequence of the lateral margin forming almost the continuation of the basal margin. The carinal margin is very convex,

the upper margin is hollowed out. The umbo is seated at the upper extremity of the carinal margin at the apex of the valve. The valve itself is divided by a ridge running from the umbo to the hardly distinct angle formed by the lateral and basal margins.

Length of the capitulum, 7 mm.

Peduncle robust; its length equals two-thirds of the length of the capitulum; covered by a very thick membrane. The scales are not very distinct. In the upper part of the peduncle they stand close to one another, in the lower part, however, they are separated by chitinous interspaces. Here they are protuberant beyond the surface of the peduncle.

Of this species I have not studied the structure of the animal contained within the capitulum; nor have I observed a complemental male at the place they ordinarily occupy.

This species was taken at Station 192, September 26, 1874; lat. 5° 42′ S., long 132° 25′ E.; depth, 129 fathoms; bottom, mud.

Observations.—This species, with regard to the structure of the valves and to the smallness of the valves of the lower whorl, is nearly related to the large deep-sea species *Scalpellum regium* and others. It is distinguished from these species by the absence of the rostrum.

Scalpellum tritonis, n. sp. (Pl. V. figs. 9, 10; Pl. X. fig. 10).

Valves covered by membrane, which is distinctly hairy. Valves thirteen. Carina simply and not very strongly bowed, with the roof flat and the umbo at the apex. Upper latus almost triangular, the carinal margin being very short. Valves of the lower whorl, with the exception of the carinal latus, not much developed. Peduncle short.

Together with some specimens of *Scalpellum stroemii*, this species was taken in the Faröe Channel, by H.M.S. "Triton." Mr. Murray asked me to insert the description of this species among those of the Challenger species.

The *capitulum*, though rather small, looks robust. Its shape is oval, a little elongate, as the apex of the tergum is produced. The number of the valves is thirteen; scutum, tergum, carina, and upper latus are well-developed; on the contrary, those of the lower whorl extremely small. The shape of the rostral latus resembles very much the shape of the same valve in those species which have the carinal latus with the umbo at the upper extremity of the carinal margin. The surface of the valves is covered by membrane, which bears numerous small hairs.

The *scutum* is convex, quadrangular. The basal margin is the shortest, and is straight, the occludent margin is arched, the tergal margin nearly straight, the lateral margin arched. The area of the valve is smaller than that of the tergum. The umbo is at the apex, which is slightly produced.

The *tergum* is triangular, large. The occludent margin is only little shorter than the occludent margin of the scutum; it is arched, hence the apex is slightly recurved. The

scutal margin is slightly convex in the middle. The carinal margin is the longest of the three; it is hollowed out in the upper, and convex in the lower portion.

The *carina* is simply bowed, large, and furnished with a flat roof. It only slightly increases in width from the upper to the lower end, and has well-developed sides at right angles to the roof. The breadth of these sides increases from the under to the upper extremity.

The *upper latus* is trapeziform, or by the shortness of the carinal margin nearly triangular. Its umbo is at its apex, which is produced and slightly protuberant over the scutum. The scutal margin is hollowed out, the tergal margin is convex, the basal margin is straight, the very short carinal margin is straight also.

The *rostral latus* is small, being only very low, especially at the rostral extremity, where the slightly protuberant umbo is situated. The height of the valve slightly increases towards the infra-median latus. A ridge, running from the umbo to the angle between the lateral and basal margins, divides the valve into two parts.

The *infra-median latus* is extremely small, triangular; it has the umbo at the apex, which is directed forward.

The *carinal latus* is rather large. The umbo is protuberant beyond the carina, and situated at a considerable distance from the apex; hence the carinal margin is divided into two parts, the larger above the umbo and a shorter part beneath it. The larger part, which is above the umbo, almost equals in length the upper margin of the valve, the lateral margin has about the same length as the smaller portion of the carinal margin. The basal margin is as long as the basal margin of the rostral latus.

Length of the capitulum, 10 mm.

The *peduncle* is cylindrical, rather robust, not quite 3 mm. long, and covered by hairy and thick membrane. The surface is beset with very protuberant scales, of which about seven form a longitudinal row, seven of these rows forming the covering of the peduncle.

Two specimens of this species were found in the Faröe Channel, at Station 10, cruise of H.M.S. "Triton," August 24, 1882; lat. 59° 40′, long. 7° 21′ W.; depth, 516 fathoms; bottom temperature, 8° C.; bottom, mud.

Observations.—This species is probably nearly related to *Scalpellum cornutum*, G. O. Sars. With regard to the structure of the complemental males, I can only say that in one of the specimens a male has been found attached to the interior side of each of the two scuta. However, the microscopic study of their organisation has given no results, because their preservation was rather bad. I have only been able to ascertain that they agree with the males of *Scalpellum intermedium* in the presence of two pairs of rudimentary valves. These valves, probably, represent the scutum and the tergum, and in the present species are not exactly of the same size; the shape of each is oval, but a larger and a smaller one are placed close to one another, and the two are separated by a somewhat greater distance from a quite similar couple of valves (Pl. X. fig. 10). This condition of the complemental male forms the transition from the structure of these males in

Scalpellum peronii, Darwin, and *Scalpellum villosum*, Darwin, to the much more rudimentary state of the males in *Scalpellum regium*, *Scalpellum darwinii*, &c. The surface of the male is clothed with rows of very minute spines.

Scalpellum novæ-zelandiæ, n. sp. (Pl. V. figs. 7, 8).

Surface of the valves covered by a very thin chitinous membrane. Valves thirteen. Carina simply bowed, with a flat roof and with the umbo at the apex. Upper latus quadrangular or rather pentagonal, the lower edge being truncated. Valves of the lower whorl well-developed. Infra-median latus elongate, quadrangular. Carinal latus large, elongate, with the umbo near the base. Peduncle short.

This little species is represented by a single specimen only. In general shape it much resembles *Scalpellum flavum*, yet I think it must be considered as specifically distinct.

The *capitulum* is elongate, flat, and consists of thirteen valves. The valves are not very close to one another, but are separated by narrow chitinous interspaces. A thin chitinous membrane covers the capitulum and adheres to its surface. Only here and there the calcareous surface of the valves appears. The elongate form of the capitulum is caused by the length of the other valves as well as by those of the lower whorl.

The *scutum* is quadrangular, not quite twice as long as broad. The umbo is at the apex, which is slightly produced and recurved, and covers a small part of the tergum. The occludent margin is arched, the basal margin also; the lateral margin is not distinct, the valve being covered here by the free edge of the upper latus.

The *tergum* is triangular, the umbo is at the slightly produced apex. The angle between the carinal and scutal margin is also produced, and nearly of the same size as the apical angle. The occludent margin is a little arched, and only a little shorter than the scutal margin.

The *carina* has the roof quite flat, and not very much increasing in width from the upper to the lower extremity. The sides are well-developed everywhere, almost of the same width and at right angles to the roof. The roof is considerably bowed.

The *upper latus* is irregularly trapeziform. The short carinal margin runs parallel with the longer scutal margin; the latter, however, is slightly hollowed out. The umbo of the valve is at the apex, which reaches over the scutum, as, though in a less degree, the whole scutal margin does. The angle formed by the scutal and basal margins is truncated, hence the valve pentagonal.

The *rostral latus* has the umbo at the upper extremity of the rostral margin. This margin is straight and rather long. The scutal margin is hollowed out, the short basal margin forms a rounded angle with the slightly arched lateral margin.

The *infra-median latus* is irregular, quadrangular, elongate, narrow. Its umbo is

placed a little beneath the middle, its rostral and carinal margins are slightly hollowed out about the height of the umbo.

The *carinal latus* is large, quadrangular. The umbo is situated near the base of the carinal margin, which is only slightly excavated for the reception of the basal portion of the carina. Its lateral margin is rather long, longer than that part of the carinal margin which is situated beneath the umbo.

Length of the capitulum, 7 mm.

The *peduncle* is short (not quite 2 mm.), cylindrical; the longest axis of the peduncle is not a continuation of the longest axis of the capitulum, but the two form an angle of about 135°. The surface of the peduncle shows rather prominent scales, which, however, are covered by membrane.

I have not studied the structure of the animal within the capitulum, nor have I observed the complemental male of this species.

The species was collected at Station 169, July 10, 1874; lat. 37° 34′ S., long. 179° 22′ E.; depth, 700 fathoms; bottom temperature, 4°·2 C.; bottom, grey ooze.

Observations.—The differences between this species and *Scalpellum flavum* will be given under that species.

Scalpellum dubium, n. sp. (Pl. IV. figs. 14, 15).

Surface of the valves covered by a very thin and hairy membrane. Valves thirteen, closely locked together. Carina simply bowed, with the umbo at the apex, with the roof not quite flat being slightly convex laterally, and not bordered by distinct ridges. Upper latus trapeziform. Infra-median latus triangular. Carinal latus rhomboid, with the umbo in the middle of the carinal margin.

This species is represented by a single specimen. Its capitulum is rather stout and flat; the carinal and rostral sides of the capitulum being nearly parallel, give it an almost rectangular shape.

Capitulum flat, covered by a thin membrane, which is much covered with hairs; the striæ on the valves, however, are not wanting, though more prominent on the valves of the lower whorl than on the others.

Scutum not very convex, with the lateral and occludent margins almost parallel; the tergal margin is slightly hollowed out, the umbo is at the apex, which projects over the tergum. The basal margin is straight, and forms an angle less than 90° with the occludent margin. Scutum about twice as long as broad, divided into two triangular parts by a ridge running from the apex to the basal-lateral angle.

Tergum triangular, with the occludent margin slightly arched, the carinal margin almost straight, and the scutal margin slightly and not very regularly undulating. The area of the tergum nearly equals that of the scutum.

Carina simply bowed, with the roof flat; the roof does not increase much in width from the apex towards the base; rather short, its base being at a considerable distance from the peduncle. The sides of the valve are much narrower in the undermost part than near the apex.

Upper latus trapeziform, in consequence of the shortness of the carinal margin almost triangular; umbo at the slightly projecting apex, scutal margin concave, basal and tergal margins almost straight.

Rostral latus irregularly quadrangular, with the umbo slightly projecting over the occludent margin of the scutum. Rostral margin short, lateral margin slightly arched.

Infra-median latus elongate-triangular, with the umbo at the apex, which is slightly bowed towards the rostral side.

Carinal latus irregularly rhomboid; the carinal margin has a short upper part, which is concave for the reception of the carina, and a convex and rather long lower part; the basal margin is very short. The umbo is at the base of the carina above the middle of the carinal margin, it is slightly projecting beyond the carina; the inferior parts of the carinal margins of the two carinal latera touch each other in the middle below the base of the carina. The carinal latus is divided into two triangular parts by a ridge running from the umbo to the angle near the apex of the infra-median latus.

Length of the capitulum, 18·5 mm.

Peduncle cylindrical, slightly bowed, and of considerable length (9 mm.). The scales are not very distinct and rounded at their free edge. There are seven longitudinal rows, each containing more than twelve scales.

I have not studied the structure of the animal within the capitulum. I have found one complemental male at the place it ordinarily occupies. It is rather large, being 1·8 mm. long, and it shows the structure of the complemental males of most of the deep-sea species. Its surface, however, does not show the little spines which ordinarily invest it. The receptaculum seminis was filled with thread-like spermatozoids.

This species was taken at Station 184, August 29, 1874; lat. 12° 8′ S., long. 145° 10′ E.; depth, 1400 fathoms; bottom temperature, 1°·8 C.; bottom, grey ooze.

Observations.—In this species the form of the carinal latus is highly characteristic. The ridge, which runs from the umbo to the point where the infra-median latus and the upper latus touch each other, divides the valve into two parts. The part which is placed beneath the ridge in shape almost entirely resembles the whole valve in *Scalpellum regium;* by the presence of the other part the valve, however, more resembles the same valve in *Scalpellum triangulare*, *Scalpellum brevecarinatum*, and others. Among the species of *Scalpellum* which have the carinal latus as in *Scalpellum regium*, and the valve as in the present species, *Scalpellum velutinum* (Pl. IV. fig. 10) may be placed; in this species the carinal latus shows a small triangular part between the ridge and the upper latus.

Scalpellum flavum, n. sp. (Pl. VI. fig. 9; Pl. X. figs. 7–9).

Valves thirteen, covered by a thin chitinous membrane. Carina very long, simply bowed, with the umbo at the apex and the roof laterally convex. Upper latus very large, quadrangular. Infra-median latus narrow. Carinal latus elongate, large, with the umbo near the base. Peduncle very short.

Three full-grown specimens of this little *Scalpellum* were brought up with the dredge, together with a specimen of *Scalpellum brevecarinatum*. The species is nearly related to *Scalpellum novæ-zelandiæ*.

Capitulum flat and elongate, and consists of thirteen valves. The valves are covered by a thin chitinous membrane; they do not show distinct lines of growth. The elongate form of the capitulum is partly due to the length of the valves of the lower whorl, partly to the length of the other ones.

Scutum quadrangular, a little more than twice as long as broad. Umbo at the apex, which slightly projects over the tergum. Lateral and occludent margins almost parallel, only very slightly arched, basal margin slightly arched.

Tergum triangular, with the occludent margin short and the two others long. The scutal margin is straight, the carinal margin distinctly arched. The occludent margin is very slightly arched.

Carina simply, rather strongly, bowed; very large; the umbo, which is at the apex, reaches to a short distance from the apex of the tergum. The roof is not quite flat, but laterally slightly convex. The sides are about of the same width over the whole length of the carina.

Upper latus quadrangular, the carinal margin parallel with the scutal margin. The edge formed by the basal and the scutal margins is truncated; hence the valve is, properly speaking, pentagonal. The scutal margin, at the end of which the umbo is placed, does not reach over the scutum.

Rostral latus almost triangular, the basal margin being very short. Umbo slightly protuberant beyond the occludent margin of the scutum. Scutal margin hollowed out. Lateral margin slightly arched.

Infra-median latus high and narrow; umbo a little beneath the middle, where the valve is a little narrower still than at the upper and lower extremities.

Carinal latus of an irregular elongate shape. The lateral margin describes a very obtuse angle with the upper margin. A large triangular portion of the valve is enclosed between the upper latus and the carina. The carinal margin is slightly concave in the upper part. The umbo is at the base of the carina, and separated from the peduncle by the short lower part of the carinal margin. Basal margin rather long.

Length of the capitulum, 7·5 mm.

Peduncle very short and narrow, and not placed in the prolongation of the capitulum; its direction forming an angle of about 135° with that of the capitulum. Scales pro-

minent with the edges rounded. Four or five are placed in a longitudinal row, of which there are about seven.

The study of the structure of the animal contained within the capitulum has yielded the following results.

Mouth.—Labrum bullate, with a row of small sharply-pointed teeth. *Mandibles* (Pl. X. fig. 7) with three teeth of nearly the same strength. Upper side of the third tooth serrated; inferior angle bearing about six strong teeth. *Maxillæ* (Pl. X. fig. 8) with the free edge straight, without any notch. The edge bears about twelve pairs of spines; the first two pairs are stronger and longer, the last three pairs are smaller than the remaining pairs. *Second maxillæ* have the so-called olfactory orifices on very long stalk-like excrescences. The anterior surface of the second maxilla bears very numerous spines.

Cirri.—The first pair has very unequal rami. The most anterior ramus is short, has only eight segments, and is rather broad. It is flat and has the shape of a table. The surface of the different segments is clothed with very numerous and slender spines, the hinder margin of each segment bears from three to six stronger spines. The segments of the posterior margin are more elongate, and as they are also more numerous than those of the other ramus (there are ten in the posterior ramus), the whole ramus is a great deal longer and more slender. The surface is also richly clothed with slender spines, but those of the hinder margin are by no means so strong, nor are they placed so regularly, as is the case on the anterior ramus. The other cirri are very slender. Those of the last pair have a two-jointed pedicel and branches of twenty-one to twenty-two segments. At the inner side each segment bears five pairs of spines: a first pair of extremely small spines, a second pair of not very stout spines, and three following pairs of long and robust spines.

The *caudal appendages* (Pl. X. fig. 9) are slender and elongate, sparingly clothed with spines. They have six, indistinctly seven segments.

The *complemental males* of this species are very small, their length being only 0·7 mm. Their structure is very simple, and much resembles that of the other true deep-sea species. They are placed, one at each side, between the scutum and the chitinous membrane; the little creature is almost totally embedded, and only a small rounded part is visible. This represents the peduncle. A rounded opening at the extremity shows the spot where the genital apparatus opens. The surface does not bear the spines, which in many other species are characteristic.

This species was dredged at Station 146, December 29, 1873; lat. 46° 46′ S., long. 45° 31′ E.; depth, 1375 fathoms; bottom temperature, 1°·5 C.; bottom, Globigerina ooze.

Observations.—This species differs from *Scalpellum novæ-zelandiæ* in the following regards:—1. In the upper latus not reaching over the scutum, and having the carinal margin longer; 2. In the roof of the carina, which is flat in *Scalpellum novæ-zelandiæ*, and convex in *Scalpellum flavum*; 3. In the length of the carina, reaching almost to the tip of the tergum in *Scalpellum flavum*, and by no means so far in *Scalpellum novæ-zelandiæ*.

Scalpellum balanoides, n. sp. (Pl. V. fig. 15; Pl. X. fig. 11; Pl. XI. figs. 1–3).

Valves thirteen, covered by thin membrane. Carina extremely short, simply, in fact hardly at all, bowed, without a distinct roof. Umbo of the carina at the apex. Upper latus triangular. Valves of the lower whorl extremely large. Carinal latus almost as high as the carina, with the umbo at the apex.

This interesting little *Scalpellum* is very remarkable by the size of the valves of the lower whorl, and has a curious shape in consequence of the great dimensions of its carinal latus.

The *capitulum* is flat, consists of thirteen valves, and is covered by a very thin membrane. The capitulum is narrow at the base, having there the same breadth as the peduncle; it is almost twice as broad in the middle, where, the carinal latus being very large, the base of the carina is to be sought for. From there it gradually slopes towards the upper extremity. Lines of growth of the different valves not very distinct.

The *scutum* is about twice as long as broad; the occludent margin is almost straight, and the umbo is at the apex of the rather sharp angle which is formed by the occludent and by the tergal margins. Tergal and lateral margins about of the same length, half as long as the occludent margin. Basal margin about at a right angle with the occludent margin.

The *tergum* is triangular, and nearly equals the scutum in size. The occludent margin is short, the scutal margin is middle-sized, slightly convex; the carinal margin is by far the longest and rather convex.

The *carina* is very short, simply, but not very strongly, bowed. The umbo is at the apex. There is no very marked limit between the roof and the sides of this valve, as is the case in the greater part of the other species.

The *upper latus* is triangular by the absence of a carinal margin. The area of the valve is not very considerable. The umbo is at the scuto-tergal angle. Scutal and tergal margins have the same length, the basal margin is a little longer.

The *rostral latus* is quadrangular. Umbo at the apex of the angle formed by the rostral and scutal margins. The basal margin is shorter than the nearly equal rostral and scutal margins. The lateral margin is a little longer than the rostral margin. A ridge running from the apex to the angle formed by the basal and lateral margins divides the valve into two triangular parts with different lines of growth.

The *infra-median latus* is elongate, triangular; the umbo is at the apex. The rostral margin is slightly concave, the carinal margin distinctly convex.

The *carinal latus* is very large. Umbo at the upper extremity of the carinal margin, convex. The carinal margins of the two valves are very long, and meet one another along nearly the whole length, beneath the base of the carina. The upper and lateral margins are nearly equal in length, the basal margin is short.

Length of the capitulum, 4·5 mm.

Length of the peduncle 2 mm. Surface of the peduncle covered by chitinous and rather prominent scales. Seven of these scales form a longitudinal row, of which there are in all five; one of these rows is placed carinally, the two other pairs both laterally.

Mouth of a very curious shape, chiefly in consequence of the great size of the second maxillæ (Pl. X. fig. 11). *Mandibles* with three teeth, the first smooth, the second and third serrated on the superior edge. Inferior angles sharply pointed, bearing six stout spines on the superior edge. The latter spines are placed very close to one another (Pl. XI. fig. 1). *Maxillæ* not very robust, slender, bearing short and not very numerous spines on the free edge. Beneath the first four spines (two of which are larger) a distinct notch is visible; the part beneath the notch is not protuberant, and bears short hairs. *Second maxillæ* very large, reaching far beyond the maxillæ (Pl. XI. fig. 2), furnished with hairs on the anterior margin.

Cirri slender and rather long. First pair with unequal rami, the shortest having six, the longest eight segments, the latter only slightly thinner than the former. Last cirrus with short segments bearing only two pairs of robust and one of very small spines at the anterior margin.

Caudal appendages elongate, very slender (Pl. XI. fig. 3), composed of twelve segments, and furnished with a few hairs only.

Penis well-developed, rather long, covered by minute hairs. Its length has not been determined, as the organ was broken off in the specimen I opened to study its organisation.

One of the specimens contained a small quantity—about twenty—of relatively large eggs. Their length only slightly surpasses their breadth (0·42 mm. and 0·35 mm.). They are all in the same stage of division, and there is no doubt that they are fecundated ova. As no complemental male was present at the place it ordinarily occupies, and as, moreover, this species was provided with a well-developed penis, I think it is very probable that minute dissection will show this species to be hermaphrodite, as most other Cirripedia are.

This species was taken at Station 192, September 26, 1874; lat. 5° 42′ S., long. 132° 25′ E.; noon; depth, 129 fathoms; bottom, mud. It was found attached to an arm of a *Comatula* or *Pentacrinus*.

Observations.—In the shortness of the carina this species much resembles *Scalpellum brevecarinatum*. However it can be easily distinguished from that species, especially by the form of the carinal latus.

Scalpellum triangulare, n. sp. (Pl. III. figs. 17, 18; Pl. XI. fig. 4).

Valves thirteen; surface of the valves covered by a rather thick chitinous membrane, furnished with short woolly hairs. Carina simply bowed, with the umbo at the apex; boat-shaped, without a flattened roof. Upper latus quadrangular, trapeziform.

Umbo of the carinal latus in the middle of the carinal margin. Peduncle short. Males, one on each side.

Of this small species four specimens were collected together with *Scalpellum parallelogramma.*

The *capitulum* is very thick and robust, especially near the peduncle, growing flatter towards the apex. The margins of the valves and the structure of the surface of the valves cannot be easily made out, as they are covered by a rather thick chitinous membrane, which is woolly, with short hairs at the surface. Valves distinctly striated when the chitin is taken away.

The *scutum* is broad, its breadth being almost two-thirds of its length, convex, quadrilateral, with the occludent margin slightly arched. Tergal margin hollowed out, lateral margin arched, basal margin almost straight. The umbo is at the apex, which projects considerably over the tergum.

The *tergum* is triangular, flat, with the inferior part produced and the occludent margin slightly convex. Its area is a little greater than that of the scutum.

The *carina* is boat-shaped, narrower at the upper than at the lower extremity. Sides only developed at the superior half of the valve, and here semilunar shaped. Striæ much more distinct, and separated by broader interspaces than on the other valves. The lines of growth are oblique. The flattened roof of the carina in most other species is totally wanting in the present species.

The *upper latus* is quadrilateral, or rather, trapeziform, the scutal margin being much longer than the carinal margin; the latter is straight, the former is distinctly hollowed out, with the angles at the upper and under extremities very sharp.

The *rostral latus* is nearly twice as long as broad, widening considerably from the rostral extremity to the opposite end.

The *infra-median latus* is small, triangular, with the umbo at the apex.

The *carinal latus* is large, greater in area than the rostral and infra-median latera together. Basal margin straight, carinal margin very concave in the superior half; the umbo of the carinal latus is placed almost in the middle of the carinal margin; inferior half of the carinal margin very convex. Upper margin straight, lateral margin also straight, making with the upper margin an angle a little greater than 90°.

Length of the capitulum about 9 mm., of the peduncle 3·5 mm.

The *peduncle* is short, with the scales in about seven longitudinal rows covered by the chitinous membrane, each row containing transversely about eight scales.

Mouth.—The *labrum* is angularly bent in the middle, the angle being directed towards the adductor muscle of the scutum. The margin of the labrum is furnished with extremely small teeth. The palpi are triangular and small, with a few hairs only at the extremity. The *mandibles* have three nearly equal and equi-distant teeth; the inferior angle is

bluntly truncated, and bears small and numerous short spines or teeth. The *maxillæ* (Pl. XI. fig. 4) have a simple edge with numerous spines; a very small notch is visible a little behind the middle. The upper spine is large, much larger than the second one. The part above the notch forms a distinct projection over the lower part. *Second maxillæ* only slightly developed, covered almost over its whole surface with numerous slender hairs.

Cirri.—First pair short, with unequal rami; the longest ramus has seven, the shortest five segments. The other cirri in the specimen I have dissected have at least one of the rami truncated, and the truncated extremity swollen in a curious way; it looks almost as if each ramus was furnished at its extremity with a number of globular vesicles.

Caudal appendages rudimentary, of one segment only.

The specimens are attached to a Sclerodermous Zoantharian (*Flabellum ?*)

A small complemental male is present at both sides, attached near the occludent margin of the scutum. It has a length of 0·88 mm., and shows a well-developed testis with a receptaculum seminis. At the anterior extremity it is furnished with well-developed antennæ; at the other extremity a circular space is to be distinguished, enclosed by a thickening of the chitinous wall of the body.

Among the eggs, which entirely fill the cavity of the capitulum, I observed a larva in the Cypris-stage. The ova were fecundated, and happened to be in one of the later cleavage-stages.

This species was taken at Station 320, February 14, 1876; lat. 37° 17′ S., long. 53° 52′ W.; depth, 600 fathoms; bottom temperature, 2°·7 C.; bottom, hard ground.

Verruca, Schumacher, 1817.

The genus *Verruca* comprises those Cirripedia which are not furnished with a peduncle, which have scuta and terga without depressor muscles, movable only on one side, on the other side united immovably with the rostrum and carina into an asymmetrical shell.

This genus is the only representative of a whole family of Cirripedia, which, according to Darwin, has affinities equally divided between the two great Families of Balanidæ and Lepadidæ; it differs from all the other genera "in the extraordinary unequal development of the two sides of the shell." Darwin gives a very extensive description of the genus and of the different species known to him. Though the Challenger brought together specimens of six different and new species of this genus, I have not been able to add so much to our knowledge of the genus as I should have wished, except as far as regards its geographical and bathymetrical distribution. All the species are relatively small, and most of them are represented by one or two specimens only.

Darwin describes four recent species of this genus: *Verruca strömia*, O. F. Müller, sp., which inhabits the shores of northern Europe, and which is found fossil also in Glacial deposits of Scotland, &c., &c.; *Verruca laevigata*, G. B. Sowerby, extending from

Tierra del Fuego up the west coast of America to Peru; *Verruca spengleri*, Darwin, from Madeira; and *Verruca nexa*, Darwin, from the West Indies. Besides *Verruca strömia*, O. F. Müller, another fossil species has been discovered since the appearance of Bosquet's Monographie des Crustacés fossiles du Terrain Crétacé du Duché de Limbourg,[1] viz., *Verruca prisca*, Bosquet, which was found also in chalk in Norwich. As far as my knowledge goes, no descriptions of new species have been published since the appearance of Darwin's Monograph. On six different occasions H.M.S. Challenger collected specimens of this genus. They are, no doubt, some of the more interesting forms of animal life collected during the expedition: in the first place, because they show that the number of species of this genus is far greater than it has hitherto been thought; in the second place, because they show that the genus has a true world-wide distribution: of the six Stations which yielded *Verruca*, one belongs to the Northern Atlantic, three to the Southern Atlantic, one to the Pacific, and one to the Malay Archipelago; in the third place, because the range in depth of the genus is greatly extended by them, the depths inhabited by the six Challenger species being respectively 500, 520–630, 1050, 1425, 1525, and 1900 fathoms, whereas the greatest depth from which Darwin knew specimens of *Verruca strömia* to have been taken was only 90 fathoms; in the fourth place, because these new species form together a very distinct and characteristic division of the genus, showing affinity to *Verruca nexa*, as far as regards the perpendicularity of the walls, and the presence of a distinct third articular ridge on the outer surface of the scutum. In the latter respect they come also near to the fossil *Verruca prisca*.

As I pointed out already in the first chapter of this report, in the case of *Verruca*, as well as in that of *Scalpellum*, there is coincidence of great antiquity with the occurrence at a considerable depth. However, as there are also known species inhabiting rather shallow water, there should not be attached too much value to this.

The specimens collected during the cruise of H.M.S. Challenger in some respects closely resemble each other. I will describe them, however, as so many different species, though perhaps future investigations may show that, at least some of them, must be considered as local varieties of one and the same species.

For the determination of the species of this genus I have composed the following table:—

Verruca.

I. Shell much depressed, irregularly circular.
  1. Under side of the movable scutum with a prominent adductor ridge, — *Verruca spengleri*, Darwin.
  II. Under side of the movable scutum with a slight depression for the adductor muscle.
    (*a*) Lower articular ridge of the movable scutum not half as broad as the upper articular ridge, ... — *Verruca strömia*, O. F. Müller, sp.
    (*b*) Lower articular ridge broader than the upper articular ridge, . — *Verruca laevigata*, G. B. Sowerby.

[1] Bosquet, Monographie des Crustacés fossiles du Terrain Crétacé de Limbourg, 1853.

II. Shell not depressed.
- I. Movable scutum with three prominent longitudinal ridges, . . *Verruca nexa*, Darwin.
- II. Only one prominent longitudinal ridge is developed.
  - (*a*) Longitudinal ridge separated by a broad interspace from the tergal margin.
    - 1. Apex of the movable scutum projecting freely, . . *Verruca sulcata*, n. sp.
    - 2. Apex of the movable scutum not projecting freely, . *Verruca gibbosa*, n. sp.
  - (*b*) Longitudinal ridge separated by a narrow interspace from the tergal margin.
    - 1. Immovable scutum divided into two triangular parts forming an angle together, ... *Verruca nitida*, n. sp.
    - 2. Immovable scutum convex, ... *Verruca quadrangularis*, n. sp.
  - (*c*) Longitudinal ridge close to the tergal margin.
    - 1. Apex of the carina very prominent and sharp, . . *Verruca obliqua*, n. sp.
    - 2. Apex of the carina not very prominent, . . . *Verruca incerta*, n. sp.

Verruca gibbosa, n. sp. (Pl. VI. figs. 17, 18; Pl. XI. figs. 5–9; Pl. XII. figs. 1–5).

Shell white; surface smooth, with very prominent growth-ridges and furrows between the articulating ridges; walls almost perpendicular to the surface of attachment; base nearly triangular, not very narrow. Movable scutum rather large, with the upper articular ridge hardly distinguishable, and a very prominent third articular ridge, which is separated from the tergal margin by a rather broad interspace; apex pointed, not projecting freely; apex of the movable tergum almost pointed. Apex of the carina and rostrum recurved, and projecting freely beyond the surface of the shell. Rostrum and immovable scutum bulky.

This is the largest and the most beautiful of the deep-sea species. It is represented by four well-developed specimens.

The surface of the shell is naked, no trace of a chitinous membrane being visible. The growth-ridges can be distinctly made out on the operculum as well as on the other valves. The surface of the rostrum and the carina, as well as that of the immovable scutum is furnished with single deep furrows, which serve for the articulation of the valves.

The movable scutum and tergum are by no means at right angles with the fixed pair; they form one of the sides of a triangular pyramid, the two other sides of which are formed by the immovable scutum and tergum. These latter are extremely steep. In most specimens the movable scutum and tergum lie in a flat plane with part of the carina and of the rostrum; in one of the specimens (that figured Pl. VI. fig. 17) the rostrum is convex beyond that plane. Of the sutures, that between the carina and rostrum is very characteristically toothed; that between the immovable scutum and immovable tergum is not so obscure as in other species of the genus; the immovable scutum shows a kind of radius, which slightly projects over the immovable tergum. The carina also is furnished

with a kind of radius, which projects over the immovable tergum. The articulation of the rostrum with the fixed scutum is the least distinct of all.

When the operculum is taken away, the orifice resembles a scalene triangle; one side (the shortest) is formed by the occludent margin of the fixed tergum; the second side partly by the occludent margin of the fixed scutum; the third (the longest) side by the upper margin of carina and rostrum combined.

The *movable scutum* (Pl. XII. figs. 2 and 4) is not very small, its area equalling nearly two-thirds of that of the movable tergum. Its shape is triangular; the tergal and basal margins are about at right angles to each other, and the occludent margin is curved. The length of the basal margin is not quite half the length of the tergal margin. The valve is very thick, especially towards the apex; when investigated from the under side, the surface appears to be bordered by a well-developed rim along the occludent margin. This rim separates a rather deep depression for the adductor muscle from the occludent margin. Towards the sharply pointed apex the rim slightly increases in width. The tergal margin is straight; the upper articular ridge is hardly visible, most probably it is represented by the edge of the valve itself, which forms a furrow with a very short ridge at the under side of the valve near the apex; the second (lower) articular ridge, on the contrary, is well-developed, and is almost parallel to what I propose to consider as a third articular ridge. The latter, which can be also regarded as an axial ridge, runs from the apex to the basi-tergal corner of the valve, is very prominent, grows slightly broader towards the under extremity, and here projects slightly. It corresponds exactly to the third articular ridge of the tergum, which is also considered as such by Darwin. The second articular ridge describes a curve, and has a narrow semi-circular part of the valve between itself and the tergal margin. In this part of the valve the lines of growth are very oblique on the tergal margin of the valve. The part of the valve which is enclosed between the third articular ridge and the occludent margin forms the greatest half of it, and has the ridges of growth in the inferior part parallel to the basal margin; towards the upper extremity the ridges are slightly divergent.

The *movable tergum* (Pl. XII. figs. 1 and 5) is broad and quadrangular. The valve is divided into two triangular parts by the beautifully curved axial or third articular ridge. In that part of the valve which lies between this ridge and the occludent margin, the lines of growth are parallel to the basal margin; in the other half these lines are parallel to the scutal margin. The axial ridge widens downwards and projects very distinctly at the basal point of the valve. The middle articular ridge is close to the axial ridge, and is separated by a somewhat greater distance from the upper, or first articular ridge. Its free edge is formed by the occludent margin of the valve, but it grows broader towards the scutal margin, where it is produced into a slight projection. The occludent margin of the valve consists of two parts, separated by the umbo or apex of the valve,—one beneath the apex (and this part is curved) and the other between this apex and the scutal

margin. The latter part is slightly concave. The apex is bluntly pointed. At the under side the valve shows a distinct rim at both occludent margins; this rim slightly increases in width towards the apex of the valve, where the two meet.

The *fixed scutum* is shorter, but perhaps a little broader towards the base than the fixed tergum. The shape of the valve is triangular, and being very broad and convex at the base, and pointed, slightly beaked at the apex, it resembles half the surface of a conus. The occludent margin is hollowed out for the reception of the corresponding margin of the movable scutum; it forms the free edge of a separate and inflected portion of the valve, which is extremely narrow upwards and distinctly widens downwards. At the tergal margin a kind of radius is visible, which projects over the free edge of the fixed tergum; at the upper half it is extremely narrow and hardly visible, at the under half, on the contrary, it forms a rather broad and triangular portion. The basal margin is very irregularly toothed. The umbo is at the apex; the valve is added to at its inferior extremity. The lines of growth are distinct, but have a very irregular course.

The *fixed tergum* has a very irregular shape; it consists of three portions—a middle and two lateral ones. The middle portion is very narrow at the apex, and increases considerably in width towards the base. It projects very much over the surface of the two lateral parts, hence may be considered as a kind of rim; it is curved, and projects very much beyond the basal margins of the two lateral parts. The valve has two occludent margins which meet at the apex. Of the lateral portions, one is placed between the rim and the immovable scutum, and this is added to in a direction parallel to the scutal margin; it has an irregular triangular shape and a short occludent margin. The other lateral portion is triangular also; it has a longer occludent margin at the edge of a narrow part which is bent forward. Its basal margin is the margin with which it touches the carina; the lines of growth of this valve are parallel to the latter margin. The projecting middle part of the valve probably corresponds to the spur which is so well-developed in most species of *Balanus*. When seen from the under side, the valve consists of two parts, meeting in a line running longitudinally in the middle of the projecting middle portion. These two parts describe together a distinct angle.

Rostrum and *carina* are both triangular in outline. The rostrum is more convex and a little more robust. Both valves have the umbones in their normal places. However, in both they project freely beyond the edge formed by the scutum and tergum. This projecting portion is larger in the carina than in the rostrum; moreover, it is slightly recurved in the former and curved inward in the latter. Both valves are furnished with one very distinct and two rather shallow longitudinal furrows, and where the valves meet each other, it is into these furrows that the well-developed teeth of the other valve penetrate. The lines of growth are rather distinct, and, though not very regular, they are about perpendicular to the direction of these furrows. The number of teeth by which

the two valves are united together is three. The basal margins of these valves are also very irregular. The occludent margin of both valves is furnished with a distinct but narrow ridge.

Basis.—I have not distinctly observed the basal membrane. The interspace left open between the basal edges of the parietes is narrow, and has a very irregular shape.

Body of the animal.—The body is much flattened; yet it does not lie parallel to the surface of attachment, as, according to Darwin, is the case in the other species of the genus. The mouth is flattened, it is not bullate, and it stands at a distance from the adductor scutorum muscle. The *labrum* (Pl. XI. fig. 5) has its crest surmounted by a row of very numerous and small teeth; the palpi are of moderate size, but the tips are very distant from each other. They are not curved, but they bear, as in the species described by Darwin, the bristles only on their outer sides and extremities. The rounded swelling on each side of the labrum to which they are attached is present, as Darwin has indicated. The *mandibles* in this genus, according to Darwin, have three upper main teeth, with two or three minute lower teeth, or (in *Verruca nexa*) with the lower part pectinated with small spines. The present species has the mandibles as in the latter species (Pl. XI. figs. 6 and 6*). The only point to be added is, that in the specimen I have investigated the mandible of the one side was furnished with three, that of the other with four, teeth; an asymmetry to which we must not attach too great importance. The *maxillæ* (Pl. XI. fig. 7) have a very deep notch behind the two upper larger spines; the lower part is rather narrow, and bears some spines, which are not very strong. This lower part forms a step-like projection. The *outer maxillæ* (Pl. XI. fig. 8) are slightly prominent, and not deeply lobed on their inner surfaces. They are clothed with bristles.

Cirri (Pl. XI. fig. 9).—The first pair is relatively stout, and the pedicels especially are well developed. The two rami are equal in length and thickness, and both have thirteen segments. These segments are thickly clothed with spines. The *second pair* has the posterior ramus much longer than the anterior; it is almost twice as long; the number of segments of the short ramus is eight; that of the long ramus thirteen. The two rami of the *third pair* show only a very slight difference in length. The fourth to the sixth pairs have numerous elongated segments, bearing as a rule three pairs of long slender spines in front and two or three slender spines on the dorsal edge of each segment.

Caudal appendages long and slender, and having eleven segments in the specimen I investigated. The *penis* is long and slightly swollen at the extremity.

This species was found attached to the strongly corroded surface of a part of a shell, the nature of which I was unable to ascertain.

The specimen of this species which I dissected contained eggs. These were in a very early stage; their shape was not very elongate, their longest and shortest dimensions being respectively 0·415 and 0·32 mm. The average size of the specimens was 8 mm. in height and 9 mm. distance from the apex of the rostrum to that of the carina.

Four specimens of the species were taken at Station 317, February 8, 1876, lat. 48° 37′ S., long. 55° 17′ W.; depth, 1035 fathoms; bottom temperature, 1°·7 C.; bottom, hard ground.

Observations.—As I said when treating of the genus, the deep-sea *Verrucæ* resemble in some respects *Verruca nexa*, Darwin. However, of the three strongly prominent longitudinal ridges on the scutum of that species, only one (my third articular ridge) is represented in the deep-sea species; moreover, the strongly-ribbed appearance of the whole shell is wanting in the deep-sea species, and finally, the shape of the valves is different. With regard to the parts of the mouth, we find some corresponding features: the shortness of the palpi of the labrum, the presence of the bead-like teeth on the crest of the labrum, the pectinated condition of the lower part of the mandible, &c. The cirri are slightly different as far as the length of the rami, &c., is concerned. As I was not able to investigate the same details in all the deep-sea specimens of different localities, I cannot say whether they all correspond to one another with regard to the structure of the animal's body. There can be no doubt, however, that the deep-sea species, of which the form I called *Verruca gibbosa* has been studied most accurately, are different from those which occur in shallow water, and which were described by Darwin. On the contrary, I am by no means sure that the forms which will hereafter be described as different species must really be considered as such. For whilst I shall give a detailed description of one of the other species (*Verruca quadrangularis*), in the case of the remaining ones I shall only point out the differences which seem to prevent their being described as belonging to one of the other species. Later investigations, made with the aid of a much richer material, will perhaps show that the different deep-sea *Verrucæ* are much more nearly related than I could ascertain.

Verruca nitida, n. sp. (Pl. XII. figs. 6, 7).

Shell white and very flat; surface smooth, with not very prominent growth-ridges. Walls almost perpendicular to the surface of attachment, which being narrow causes the base to be narrow also. Movable scutum relatively large, with a sharply pointed apex: its upper articular ridge can hardly be made out, the third articular ridge, on the contrary, is well developed; interspace between the third articular ridge and the tergal margin narrow. Movable tergum with the apex slightly bowed and blunt. Apex of the carina strongly projecting. The carina articulates with the rostrum by means of a single large tooth, which forms part of the latter valve. Immovable scutum divided into two triangular parts forming an angle with each other.

There is only a single specimen which shows the characters given above. It was taken in the Moluccan Archipelago, and there can be no doubt that it belongs to the

same subdivision of the genus as *Verruca gibbosa*. It is distinct from this species in the first place on account of its greater smoothness; neither the growth-ridges nor the furrows are so distinctly visible as in the former species. The tergum and scutum in general outline much resemble the same valves in *Verruca gibbosa*, but the articular ridges are by no means so distinct. The rostrum and the immovable scutum are not nearly so bullate as in the former species, and the apex of the rostrum is scarcely freely projecting; on the other hand, the carina has the apex very strongly projecting. The most interesting and certainly the most striking point of difference is the way in which the rostrum and the carina articulate together: whereas in *Verruca gibbosa* the rostrum is furnished with three very distinct teeth, which are placed in excavations of the other valve, in *Verruca nitida* only one tooth, which corresponds to the strongest and uppermost one of the other species, can be distinguished; beneath this tooth the two valves unite in a straight line. The immovable tergum and scutum do not form a perfectly flat plane; the apex of both valves is reflected, so that the surface of the valves is slightly concave. The immovable scutum is furnished with a narrow kind of radius, and is divided into two parts, which are placed angularly to each other and meet in a curved line. The apex of the immovable scutum is distinctly beaked, and projects for a considerable way over the immovable tergum. The latter is divided into a middle part and two lateral parts as in the foregoing species.

The only specimen is attached to what may be considered one of the tentacles of a *Pentacrinus*. Its colour is white, its surface is not covered with membrane.

The size of the specimen is 5·5 mm. It was taken at Station 214, February 10, 1875; lat. 4° 33′ N., long. 127° 6′ E.; depth, 500 fathoms; bottom temperature, 5°·3 C.; bottom, Globigerina ooze.

Verruca sulcata, n. sp. (Pl. VI. figs. 19 and 20).

Shell dirty white; flat, especially at the side of the immovable scutum and tergum. Surface with prominent growth-ridges; articular ridges of the scutum and tergum prominent, as are also those of the carina and rostrum. Walls perpendicular to the surface of attachment. Movable scutum rather large, with the apex pointed and projecting freely. Upper articular ridge hardly distinguishable, middle articular ridge penetrates with a sharp tooth between the two ridges of the tergum. Third articular ridge very prominent. The slightly convex rostrum has four teeth, which alternate with three teeth of the carina, and by means of which the valves are united together.

This elegant little form also is represented by a single specimen only. It has the same general appearance as the former species. However, it is not difficult to distinguish it; its scutum is relatively large, and the middle articular ridge terminates below in a very prominent tooth; the third articular ridge is very strongly developed.

The tergum is quadrangular, its apex is not blunt, though not very pointed. The rostrum is distinctly convex, and is furnished with three furrows, which run from the apex to the rostro-carinal margin; this margin shows three excavations separated by teeth. The apex of the valve slightly projects beyond the scutum. The carina has the apex projecting much farther, and is more slender than the rostrum; the furrows on its surface are still deeper than those of the rostrum. The immovable scutum consists of two triangular parts; a large one with a beaked apex, and another one much narrower and forming almost a right angle with the former. A well-developed radius covers a considerable part of the immovable tergum. This consists of a middle portion, which is curved, narrow at the apex, and very broad at the base; a distinct oval portion, which is placed between the middle portion and the immovable scutum; and, finally, a second lateral portion, which is quite on the carinal side of the shell. This latter portion is very narrow at the apex, and does not increase much in width downwards. It can be traced to where it reaches the carina.

In this species the form of the immovable scutum and tergum is no doubt most peculiar; the great flatness of the main portions, together with the almost perpendicular position of the lateral parts, is in none of the other species so striking. The species is also remarkable for the strong development of the furrows and ridges, both on the scutum and tergum and on the rostrum and carina.

The height of the specimen is 5·5 mm., the distance from the apex of the carina to that of the rostrum is not quite 5 mm. The specimen was found attached to what I think is a piece of a Polyzoon. It was taken in the Pacific Ocean; the bottle has the Station number 170; according to the printed list of Stations two dredgings were taken at this Station. I feel unable to decide from which of these the animal was procured, so I give them both.

Station 170, July 14, 1874; lat. 29° 55′ S., long. 178° 14′ W.; depth, 520 fathoms; bottom temperature, 6°·0 C.; bottom, rocks. Lat. 29° 45′ S., long. 178° 11′ W.; depth, 630 fathoms; bottom temperature, 4°·0 C.; bottom, rocks.

Verruca quadrangularis, n. sp. (Pl. XI. figs. 10, 11; Pl. XII. figs. 8–12).

Shell dirty white; surface smooth, with not very prominent growth-ridges. Walls nearly parallel to each other and perpendicular to the surface of attachment. Base elongate oval. Movable scutum relatively large, with the upper articular ridge not distinguishable, and with a very prominent third articular ridge. This ridge is separated from the tergal margin by a narrow interspace. Movable tergum almost regularly rhomboid, with a recurved and blunt apex. Apex of the carina projecting freely; that of the quadrangular rostrum does not project, or only very little. Rostrum and carina articulate together by means of two teeth on each of the two valves.

This species is represented by half a dozen specimens. Unfortunately they suffered from the alcohol having somewhat evaporated. I believe that they can be easily distinguished from the other nearly related species, as well by the form of the scutum and tergum as by that of the immovable valves.

In the *scutum* I did not observe a trace of a first articular ridge. The curve described by the third articular ridge is not, by far, so strongly marked as in *Verruca gibbosa*. Hence the part enclosed between this ridge and the tergal margin is relatively small. The apex is pointed and slightly beaked.

The *tergum* has the apex very blunt; that part of the occludent margin which runs from the apex to the scutal margin is relatively long, and runs nearly parallel to the basal margin. This causes the whole valve to have an almost regular rhomboidal shape.

The *carina* is rather small; its apex as a rule projects freely. Its lateral margin runs almost parallel to the same margin of the rostrum, and so the shell acquires a quadrangular shape.

The *rostrum* is comparatively large, slightly convex, with the basal and upper margins parallel to each other. The two valves articulate together by means of two teeth and two excavations, present as well at the rostral margin of the carina as at the carinal margin of the rostrum.

The *immovable tergum* is much larger than the *immovable scutum*. Both valves are almost regularly triangular and convex. Both have the apices bluntly pointed. The immovable tergum consists of a middle portion and two lateral portions which almost resemble alæ, the immovable scutum has a middle portion also; this is, however, relatively broader; the lateral portions form a series of rays, which are very narrow.

This species lives attached to black coloured horny hollow tubes, which, perhaps, were once inhabited by Annelid worms. The basal edges of the immovable valves are slightly rectangularly inflected, so as to form a ledge round the base. This ledge in the middle of each valve is rather more strongly developed than at both extremities. Hence the margin round the base appears slightly undulating. As this species was represented by numerous specimens, I was enabled to compare also the structure of the animal with that of *Verruca gibbosa*. Though in general a great conformity was observed, there can be no doubt, I believe, that the two species are really different. The following differences can be pointed out as of greater importance.

Mouth.—The *labrum* has the teeth more numerous and also a little more distinct; the *palpi* are slenderer; the hairs on the palpi are not only present at the extremity and on the outer margin, but also on the surface. The *mandibles* (Pl. XI. fig. 10) have three teeth, the third in the outer margin is furnished with notches, and hence looks serrated. The teeth on the inferior angle are not so regular as in *Verruca gibbosa*; they are fewer in number and they present much more strongly marked differences as to their size. The *maxillæ* (Pl. XI. fig. 11) have the notch not so wide as in *Verruca gibbosa*; the spines

along the margin of the notch are a great deal stouter than in the other species. The step-like inferior part is much stouter and broader. The *outer maxillæ* are much less hairy than in *Verruca gibbosa*.

Cirri.—Pedicels of first pair much less developed than in *Verruca gibbosa*. First pair has the rami of equal length, but not of the same number of segments; the posterior ramus has seven segments, the anterior one has ten; the length of the third to the fifth segments of the posterior ramus almost corresponds to the length of the third to the eighth segments of the anterior ramus. The second cirrus has also slightly unequal rami; the shortest ramus has seven, the longest nine, segments. The third cirrus has the rami of equal length, but the number of segments in the two rami is slightly different, being fourteen in the one and fifteen in the other ramus.

Caudal appendages slender, number of segments eight.

Seven specimens of this species were collected at Station 323, February 28, 1876; lat. 35° 39′ S., long. 50° 47′ W.; depth, 1900 fathoms; bottom temperature, 0°·0 C.; bottom, grey mud.

Verruca incerta, n. sp. (Pl. XII. figs. 13, 14).

Shell rose-coloured (?). Surface with prominent growth-ridges, which, however, are not numerous on the rostrum and carina. Walls perpendicular to the surface of attachment. Base narrow, the inferior part of the walls—especially of the rostrum and carina—turned over so as almost to enclose the thread-like spine to which the animal is attached. Movable scutum relatively small; upper articular ridge not visible, third ridge well developed. That part of the scutum which is placed between the third ridge and the tergum extremely narrow. Apex of the scutum pointed. Movable tergum almost rhomboidal, with a blunt apex, and with the middle ridge almost invisible. Apex of the carina only slightly projecting beyond the surface of the shell.

Of this form I received two specimens mounted in balsam. They are feebly rose-coloured; whether this is a natural colour or has been artificially produced I cannot say. Inequalities (ridges and furrows) of the surface show the colour more distinctly, and this, as well as the circumstance that the spine to which the specimens are attached is coloured also, would suggest to us that it is not a natural colour. Of the two specimens one is slightly larger than the other; my definition and description have reference to the larger specimen more especially. The scutum is small, its occludent margin is very strongly arched, its tergal margin is hollowed out, its apex pointed. The occludent margin is slightly reflected outwards, and in this way a kind of ridge along that margin is formed. The tergum is quadrangular, almost completely rhomboid. The lower articular ridge is strongly developed, the upper by no means so distinctly, and the middle ridge is hardly visible,

The margin separating the rostrum and the carina can hardly be made out (in the other, smaller specimen, it is more easily distinguishable). The number of teeth by which the two valves articulate together is only a single distinct one at the rostrum and two at the carina. The apex of the rostrum does not project beyond the surface of the valve, that of the carina only slightly. Both valves, but especially the rostrum, are slightly bulky. The lower extremity describes a kind of bellying beyond the spine to which the animal is attached; at the other side of the spine, the lower edge of the carina and rostrum, being turned over, almost touches the basal margin of the fixed scutum and tergum. The growth-ridges of both valves are very distinct, but they are at considerable distances from each other. The immovable scutum is relatively small; its shape is triangular; it projects with a rather broad radius over the immovable tergum. A considerable part of this valve is to be seen on the side of the movable valves. The apex is bluntly pointed. The immovable tergum is large, bluntly pointed also, and indistinctly divided into a middle and two lateral portions. The immovable tergum has a much greater area than the immovable scutum, and reaches considerably higher upwards than the scutum does.

According to the label of the microscopic preparation, the present species lives attached to the spine of a deep-sea Echinid of the genus *Salenia*. The species was taken in the Southern Atlantic, at Station 335, March 16, 1876; lat. 32° 24′ S., long. 13° 5′ W.; depth, 1425 fathoms; bottom temperature, 2°·3 C.; bottom, Globigerina ooze.

Verruca obliqua, n. sp. (Pl. XII. figs. 15–17).

Shell white; surface with not very prominent growth-ridges. Shell placed obliquely on the surface of the object to which it is attached. Scutum triangular, narrow; the part between the third articular ridge and the tergal margin almost wanting. Tergum with a very blunt apex; quadrangular. Rostrum quadrangular, relatively large, slightly convex; apex in one of the specimens projecting freely, in the others not projecting. Carina with the apex projecting freely and reaching a great deal higher up than the apex of the rostrum does. The carinal margin of the rostrum is furnished with a single tooth, by means of which the valves articulate with one another.

This distinct form is represented by four very small specimens. Their most prominent characteristic is the form of the scutum, which is very narrow; the whole of it represents that part of the scutum in the other deep-sea species which is situated between the third articular ridge and the occludent margin. A second character is furnished by the carina. In all the deep-sea species of the genus *Verruca* this valve has indeed the shape of a keel, but the part which is placed at the side of the movable scutum and tergum is always very large; the other part, at the side of the immovable valves, is

narrow and hardly visible. The line where the two parts meet in other species is slightly concave; in this species, however, it is either straight or even slightly convex. The apex of the carina, moreover, is at a much greater distance from the base in comparison with the apex of the rostrum than is the case in the other species. In most specimens the rostrum and the carina articulate together, as in *Verruca nitida*, by means of a single tooth. The form of the shell, however, comes much nearer to that of *Verruca quadrangularis*.

The fixed scutum and tergum are both elongate. The fixed scutum is triangular, relatively large, and very convex, especially close to the basis. The fixed tergum has a very narrow basal margin, but grows considerably broader towards the middle of the valve. Its apex is like that of the scutum bluntly pointed.

Two of the specimens are attached to small pieces of shell, the two others to small horny tubes, wide at one extremity, and narrow, pointed, and closed at the other. I think these are tubes once inhabited by small Annelids.

This species was taken in the North Atlantic at Station VI., January 30, 1873; lat. 36° 23′ N., long. 11° 18′ W.; depth, 1525 fathoms; bottom temperature, 1°·6 C.; bottom, Globigerina ooze.

Observations.—Together with the four specimens, for which I propose the name *Verruca obliqua*, another representative of the same genus was dredged. In most respects this specimen is different, but especially in the form and relative size of the scutum; it is not only much larger, but it has, moreover, a distinct, freely projecting apex. The tergum much resembles the same valve in most other species of this genus; it is, however, incomplete in the present specimen, its apex being broken off. Rostrum and carina form together a shell, which is broader than that of *Verruca obliqua*, and at the same time is not so high. In this respect it resembles *Verruca nitida*. The immovable tergum and scutum are intermediate between those of *Verruca nitida* and of *Verruca obliqua*. I figure the specimen in Pl. XII. fig. 17. I indicate it as *Verruca obliqua*, var.; I should find it, however, rather difficult to say why it is considered as a variety of this species, and not, *e.g.*, of *Verruca nitida*.

Balanus, Auctorum.

"It is not easy," Darwin says (*loc. cit.*, p. 185), "to exaggerate the difficulty of identifying the species, except by a deliberate examination of the internal and external structure of each individual specimen." If Darwin came to this conclusion, after a study of years, making use of the very rich collections of the British and other museums, and of private collections (in the first place his own, chiefly made during the voyage of the "Beagle"), I need hardly tell how great are the difficulties which I have had to surmount in identifying

the species collected during the cruise of H.M.S. Challenger, as I have neither the long experience of the great monographist, nor the disposal of collections comprising very numerous species.[1] It is true we possess at present all the information laid down by Darwin in his monograph; yet the difficulties with which one has to struggle in determining supposed new species of this genus are very considerable, and may be fairly judged from the curious fact, that in the nearly thirty years which have elapsed since the publication of Darwin's book, only *one* species (*Balanus armatus*, Fritz Müller) has been added to the genus—a genus of which Darwin knew forty-five species—representatives of which may be collected almost everywhere, and on every coast. Many authors, no doubt, have been engaged in investigating species belonging to this genus, and must have met with forms which could not in a very natural way be classed among any of the species described by Darwin. However, as they had not at their disposal a very rich material for comparison, they must have been left in doubt, and hesitated to introduce it into science as a new species. I think, in most cases, these authors have been right in doing so; yet I believe that in some cases the publication of a description, illustrated with good figures, may be useful for the development of our knowledge of the genus and the distribution of its species. Should the identity of any species with one described already before be proved afterwards, as may result from a comparative study of good descriptions and figures, I cannot understand what harm is done to science.

In consequence of the admirable completeness with which Darwin has given in his monograph the descriptions of the species, it has been possible, even easy, to identify with certainty seven of the twelve samples of specimens with species already described. Two of these belong to *Balanus tintinnabulum*, Linn., two to *Balanus trigonus*, Darwin, one to *Balanus lævis*, Bruguière, and two to *Balanus amaryllis*, Darwin. With the five remaining groups this has not been possible. Of these three consist of specimens belonging to species which I have described as new, but which probably are nearly related to species described by Darwin; at least it was possible to rank them with the species of Darwin in the sections into which he proposes to divide the genus. The two other samples of specimens, on the contrary, represent two closely allied but distinct species, which, however, scarcely admit of comparison with species Darwin knew. They form a distinct section of the genus. I was for some time uncertain whether it was not necessary to establish a new genus for their reception. I have not done so, however, because both species come very well within the genus *Balanus*, as characterised by Darwin (compartments six; basis calcareous or membranous; opercular valves sub-triangular). Under *Balanus corolliformis* I will give the characteristics of

[1] Of the forty-five species described by Darwin, I only know the following by my own examination:—*Balanus tintinnabulum*, Linn. (different varieties); *Balanus psittacus*, Molina, sp.; *Balanus trigonus*, Darwin; *Balanus lævis*, Brug.; *Balanus perforatus*, Brug.; *Balanus amphitrite*, Darwin; *Balanus improvisus*, Darwin; *Balanus porcatus*, da Costa: *Balanus crenatus*, Brug.; *Balanus balanoides*, Linn.; *Balanus hameri*, Ascanius; *Balanus amaryllis*, Darwin.

this new section of the genus. I only wish to add here that one of the peculiarities of the new section is that both species are representatives of the deep-water fauna, one being found at a depth of 150 fathoms, the other of even 516 fathoms, and that some of the peculiarities of their structure (of the compartments at least) must be regarded as standing in near relation to their living at so considerable a depth. *Balanus crenatus*, Brug., according to Darwin, lives at a depth down to 50 fathoms; *Balanus porcatus*, da Costa, was dredged during one of the cruises of the Dutch schooner "Willem Barents" (Barents Sea), at a depth of 140 fathoms; the Challenger took another *Balanus* (which I consider as new to science, and for which I propose the name of *Balanus tenuis*) in the Philippine Archipelago, at a depth of 300 fathoms. In this latter species, probably, as well as in the two preceding ones, we have littoral forms in the sense of A. Agassiz,—forms extending from the shore down to 180 fathoms. On the contrary, *Balanus corolliformis* might be considered as a deep-sea species, the upward limit of whose distribution rises as high as 180 fathoms. Of course future dredgings will have to show whether this suggestion is right or wrong.

As the number of species in this genus which I know from personal investigation is small in comparison with those which I have never seen, I have not been able to compose a synopsis for the determination of the species, as was given for the other genera of the group represented in the Challenger collections.

The sections into which the genus is now divided are :—

Section A. Parietes, and basis, and radii permeated by pores. Eight species (no new species).

B. Parietes and basis sometimes permeated by pores, sometimes not; radii not permeated by pores; shell elongated in its rostro-carinal axis; basis boat-shaped, attached to *Gorgoniæ* and *Milleporæ*. Five species (no new ones).

C. Parietes and basis permeated by pores. Radii not permeated by pores. Thirteen species (two new ones, *Balanus armatus*, F. Müller, and *Balanus socialis*, n. sp.).

D. Parietes permeated by pores. Basis and radii not permeated by pores. Five species (one new, *Balanus rostratus*, n. sp.).

E. Basis membranous. Three species (no new ones).

F. Parietes and radii not permeated by pores; basis sometimes permeated by pores, sometimes not, and sometimes excessively thin

and hardly distinguishable. Fifteen species (one new one, *Balanus tenuis*, n. sp.).

G. Parietes not permeated by pores. Radii wanting. Basis membranous. Two species (both new, *Balanus corolliformis*, n. sp., and *Balanus hirsutus*, n. sp.).

Section A. Parietes, and basis, and radii permeated by pores.

Balanus tintinnabulum, Linn. sp. (Pl. XII. figs. 18, 19).

Lepas tintinnabulum, Linnæus, Systema Naturæ, 1767.
Balanus tintinnabulum, Darwin, Balanidæ, 1854, p. 194.

According to Darwin this is one of the most difficult and variable species in the whole genus. Darwin, therefore, distinguishes eleven varieties; he does not consider them as so many different species, because by repeated and very close observation he became convinced that the several points of difference by which each variety is characterised are variable.

The species is represented by two different forms in the collection made during the cruise of the Challenger. I will treat of them separately. The first must be considered as variety (1) *communis*. It is represented by two specimens of very great size; in the largest of the two the base measures 63 × 51 mm., the height 50 mm.; the other is only a little smaller. The surface is totally hidden by a thick layer of calcareous substance; this sticks firmly to the surface; where it is taken away, the bluish-purple colour of the original shell appears.

The shape of the shell is tubulo-conical, the orifice is large, rounded, triangular, very irregularly toothed. Surface longitudinally ribbed; ribs rather strong and flexuous; radii transversely plaited in lines, slightly darker-coloured than the parietes. The sheath is not distinctly coloured and very broad. The strength of the shell is so considerable that it deserves the name of massive.

Scuta and terga with prominent lines of growth. The ribs on the surface of the scuta are finely toothed. The basi-tergal corner of the scutum is very much rounded off. Articular ridge broad and much reflexed; it is very slightly hooked. Adductor ridge not quite confluent with the articular ridge, bounding the cavity for the depressor muscle; it is rather prominent, as Darwin says it generally is in var. *coccopoma* and var. *concinnus*. The cavity for the lateral depressor muscle is deep, as, according to Darwin, is only the case in the two varieties just mentioned, and sometimes in var. *communis*. The surface of the valve is slightly externally depressed in the line of the adductor ridge.

The tergum is broad, the longitudinal furrow is closed. Apex only indistinctly

beaked. Spur placed in the middle of the basal margin. The basal margin, on opposite sides of the spur, does not form a nearly straight line, the scutal portion is about at right angles with the spur; the carinal portion descends nearly as low as the scutal half, but it is hollowed out in the middle, and describes with the spur an angle less than a right angle. The spur is relatively stout; its breadth is exactly one-fourth of the breadth of the valve. The scutal margin is very broadly inflected, the inflected portion forms less than a right angle with the interior surface of the valve. The articular ridge is very prominent and nearly straight; it extends about half-way down the valve. The spur is produced for a considerable distance up the internal surface of the valve as a prominence. The crests for the tergal depressor muscle are well developed. The scuta and terga were calcified together; but they readily became loose after having been boiled in caustic potash.

Judging from the form of the scutum, our specimens might be considered either as var. *coccopoma*, as var. *concinnus*, or as var. *communis*. However, var. *coccopoma* is globulo-conical, with a small rounded orifice, and generally has smooth walls, and this is not the case at all with the specimens under consideration. Var. *concinnus* is also globulo-conical, and has finely ribbed walls. Its scutum, moreover, shows a cavity, bordered by a plate, for the rostral depressor muscle; the cavity is present in the scutum of the Challenger specimens as it is in that of every specimen, but the plate is wanting.

The specimens collected during the cruise of H.M.S. Challenger are from St. Vincent Harbour, Cape Verde Islands. They were taken towards the end of July 1873, at a depth of from 7 to 20 fathoms. The thick calcareous layer that covers both specimens is inhabited by a small Barnacle, belonging to the genus *Chthamalus*, and identical with *Chthamalus dentatus*, Krauss.

The other form, which represents *Balanus tintinnabulum*, Linn., in the Challenger collection, is the variety (6) *spinosus* (Gmelin). This variety has been figured by Darwin, and by means of this figure, as well as his description, it is very easily distinguished; it is globulo-conical or cylindrical; its shell is rather thin, with long, nearly cylindrical, very sharp points directed upwards; colours very pale. The specimens before me are rather flat-conical, and they are not pale, but beautifully purple-coloured; the spines are especially dark. The radii are narrow and pale coloured, with slightly darker transverse lines. The orifices are very small. I tried to prepare the opercula; but, having boiled them with caustic potash, they became so very brittle as not to allow of a trustworthy inspection. The tergum is distinctly beaked, the spur rather long and placed at about its own width from the basi-scutal angle. The adductor and articular ridges of the scutum were partly broken off—so I cannot judge of them as to their distinctness, &c. The specimens are all very small; their base is nearly circular, and has in the largest specimen a diameter of about 7 mm. The height of this specimen is not quite 4 mm.

About six specimens were taken from the screw of H.M.S. Challenger when (April 1876) at St. Vincent, Cape Verde Islands, on her return homewards.

Section C. Parietes and basis permeated by pores. Radii not permeated by pores.

Balanus trigonus, Darwin (Pl. XII. fig. 20).

Balanus trigonus, Darwin, Balanidæ, 1854, p. 223.

This species belongs to the section C of Darwin; its parietes and basis are permeated by pores, its radii are not. The species was met with on two different occasions, and on both only a couple of specimens were obtained, though they are, moreover, incomplete (only one of them being furnished with opercular valves). I have not had the slightest hesitation in considering them as belonging to the above-named species; the ribbed parietes, the mottled purplish-red colour, the broad triangular orifice, are so highly characteristic as not to be easily missed. Had there still remained any doubt, the study of the scutum and tergum of the one specimen would have been sufficient to remove it; the scutum is elongate-triangular, with one distinct longitudinal row of pits; the tergum has no longitudinal furrow, the spur is truncated and very broad; its width is more than one-third of the width of the valve; the spur is situated very close to the basi-scutal angle.

One of the specimens from Port Jackson is not conical and depressed, but rather cylindrical; the shape of its rostrum, moreover, is very interesting, the parietal portion of the valve being strongly curved forward; the tip of the lateral compartment is slightly curved in the same direction. Though this specimen has no opercular valves, it can hardly be doubted, I think, that it belongs to the same species, because of the triangular shape of the orifice, because of its colour and general appearance, and finally, though this is of course not of essential importance, because of its being attached to other specimens of the same species. The ribs on the parietes, however, are not so distinctly developed as in the other specimens. I should not have insisted on this variation of the rostrum if I had not recently had submitted to me for investigation some fossil specimens of a species of *Balanus* from Tertiary deposits of Java which showed exactly the same shape of the rostrum, and in general aspect quite resembled the specimen of *Balanus trigonus* now under my inspection. Most probably *Balanus trigonus* may therefore be suspected of occurring not only in the living condition, but also as a Tertiary fossil.

The specimens collected by H.M.S. Challenger are partly from Port Jackson, Australia, April 1874, depth 6 to 15 fathoms, and partly from Kobe, Japan, May 17 to 19, 1875, depth 8 and 50 fathoms. That the present species lives at a latitude north of 34° is a new fact in its geographical distribution.

Balanus lævis, Bruguière (Pl. VII. figs. 2, 3).

Balanus lævis, Bruguière, Encyclop. Méth. (1789), pl. clxiv. fig. 1.
Balanus lævis, Darwin, Balanidæ, 1854, p. 227.

This species seems to be peculiar to the straits of Magellan; it occurs also at the west coast of South America, and even at the coast of California, but then the species has slightly altered; its shell is not covered with membrane, the orifice is slightly toothed, and it has two furrows on the scutum, whereas the Magellan specimens have only one, Darwin, therefore, considers the form that occurs at the coast of Chili, Peru, and California, a variety.

The Challenger collected numerous specimens, forming together globular masses. They are covered by dirty yellowish-brown membrane, and belong doubtless to the same form which was named by Bruguière, and afterwards elaborately described by Darwin. To his description I do not wish to add anything. I have figured a small globular mass, and a top view of the orifice, which in most specimens is strikingly toothed. The scutum has only one longitudinal furrow.

These specimens were taken in the straits of Magellan, at Station 312, January 13. 1876; lat. 53° 38′ S., long. 70° 56′ W.; depth, 10 to 15 fathoms; bottom, mud.

Balanus socialis, n. sp. (Pl. XIII. figs. 23–28).

Shell not covered by a distinct membrane; orifice relatively large, and not deeply toothed; radii extremely narrow. Tergum with a broad and short spur, and an extremely long basal margin.

In this species the walls as well as the basis are permeated by pores; the radii, however, are not permeated; whence it belongs with the preceding species to the section C of Darwin. It has a tergum of highly characteristic form (Pl. XIII. figs. 25 and 27), and it is represented by a single group of specimens attached to a very curious object, of a nature quite unknown to me. The shape of this object may be judged from fig. 23 on Pl. XIII. Its colour is black as long as it is in alcohol; when dry it is dirty brown coloured. It is hollow; it has a membranous wall within the outer thick wall. It is empty; yet I think I may conclude from the histological structure of the outer wall that it is either a fruit or the stone of a fruit.

About a dozen specimens are attached to one side of this object, which is flat and slightly hollowed out. They are rather small; the greatest diameter of the base of the largest specimen does not measure quite 5 mm.; their height is only half that length. The form of the shell is deep-conical; the orifice is slightly toothed and comparatively large; when closed the opercular valves are nearly horizontal, parallel at least to the surface of

attachment. The surface of the different *compartments* is smooth, but it is covered by a mud-like granular substance, which cannot so easily be taken away, and therefore probably is attached to a very thin and rudimentary membrane. The compartments do not show the growth-ridges very distinctly, but the opercular valves do. The internal surface of the parietes is very strongly ribbed in the lower part.

The *radii* are very narrow, their sutural edges are smooth; their summits very oblique and rounded; the alæ are rather broad, and have the summits not oblique but straight, and parallel to the basis of the shell; the alæ extend only very slightly above the level of the opercular membrane. The parietal tubes are very narrow; in the upper part of the walls they are filled up and solid. The *basis* is very thin, the layers which compose it are extremely thin and fragile; the tubes of the base run radially outwards from the centre to the periphery of the base; the tubes are extremely narrow, and as the base is too thin to permit of a transverse section, the presence of the tubes is always to a certain degree problematic.

The *scutum* is triangular, its occludent margin is slightly toothed, which is caused by the projection of the growth-ridges. The articular ridge is not very prominent, but it extends rather far downwards; the adductor ridge is hardly visible, the pit for the lateral depressor muscle and that for the adductor muscle are both very flat. The *tergum* is well characterised by the length of the basal margin, which surpasses that of the scutal margin; the two parts into which the basal margin is divided by the spur form together a straight line. The spur is short, broad, and bluntly truncated. The carinal margin is arched; the crests for the depressor muscle are very distinct. The articular furrow is not very deep, but distinct. The apex is not at all beaked.

Of the *body of the animal* I cannot give many details. In two specimens I opened I found the body shrivelled, so as to be unfit for close inspection. For want of material I could not sacrifice more. The *mouth* has a *labrum* with three well-developed and sharply-pointed teeth on each side of the notch, and with elongate palpi covered nearly all over the surface with very long hairs. The *mandibles* have only five (four, but one was broken off) blunt teeth, the *maxillæ* have the edge straight, without any notch, and armed with seven broad spines of nearly equal size, the first two being slightly stronger, besides numerous slender hairs. The *second maxillæ* are remarkably elongate. The cirri of the first pair have two very unequal rami.

This species was taken in the Arafura Sea, at Station 188, September 10, 1874; lat. 9° 59′ S., long. 139° 42′ E.; depth, 28 fathoms; bottom, mud.

Observations.—This species has, I believe, not a single near relation among the other species of the section C. On the other hand, I think it resembles much the *Balanus glandula*, Darwin, a species belonging to the section D. In most respects, however, it differs slightly even from this species, and I think, as there can hardly be doubt as to the porosity of its base, it is safest to place it in the section C.

Section D. Parietes permeated by pores. Basis and radii not permeated.

Balanus rostratus, n. sp. (Pl. XIII. figs. 16–22).

Shell white, smooth, not covered by membrane. Carino-lateral compartments very narrow; radii narrow, with their oblique summits rounded. Scutum longitudinally striated; tergum with a broad and blunt spur.

This species has a very characteristic shape, partly caused by its small orifice, partly by the great development of the rostrum and the narrowness of the carino-lateral compartments (Pl XIII. fig. 16). In this respect it resembles *Balanus lævis*, and especially the var. *nitidus*. However, in this species the basis is permeated by pores, and the scutum has longitudinal furrows, which two characteristics are wanting in the present species.

The section D of Darwin contains four species. The first, *Balanus porcatus*, remarkable for the form of its tergum, which has a produced and purple apex; the second, *Balanus patellaris*, with a depressed shell of a brown-violet colour, and an elongate rhomboidal orifice; the third, *Balanus crenatus*, the radii of which are rough and straight, and are furnished with oblique summits and with a scutum without an adductor ridge; the fourth, *Balanus glandula*, with imperfect and small pores in the parietes, which are sometimes in part absent. With none of these does the present species quite correspond, though no doubt it is nearly related to *Balanus glandula*, and also to *Balanus crenatus*.

The shell is conical, white, smooth; neither covered by membrane nor furrowed. The orifice is small and irregularly toothed. *Radii* very narrow, with rounded, oblique summits; the sutural edges of the radii are crenated. The *alæ* are also narrow, they have rounded, oblique summits like the radii. The pores of the parietes are very wide in the lower half of the valves, they are a great deal narrower in the upper half. The *base* is thin; it is finely furrowed in lines radiating from the centre. The sheath extends almost half-way down the valves; the extreme narrowness of the carino-lateral compartments in this species is very remarkable; in this respect the species comes very near to *Balanus quadrivittatus*, Darwin. The rostrum, on the contrary, is very highly developed, and forms a broad, flat valve (Pl. XIII. fig. 17).

The *scutum* (figs. 19, 20) shows very prominent lines of growth, and is distinctly striated longitudinally; the lines of growth are divided into squarish beads by the striæ; the angle formed by the tergal and basal margins is very much truncated. Internally the articular ridge is rather long, but not very prominent; the adductor ridge is distinctly visible, and extends high up on to the superior part of the valve, running almost parallel to the articular ridge; the pit for the adductor muscle is hardly visible; the cavity for the depressor muscle is rather deep. The *tergum* (figs. 18 and 21) shows traces

of longitudinal striæ; the longitudinal furrow is absent or has become closed by the sides being folded inwards. The apex is slightly beaked, the scutal margin is distinctly concave. The spur is broad and blunt, placed at less than its own width from the basi-scutal angle; the hinder side of the spur slopes into that part of the basal margin of the valve which is situated behind the spur. A very distinct articular ridge runs from the apex half way along the valve. The crests for the depressor muscles are hardly visible.

With regard to the structure of the body of the animal, the following details may find a place here.

The *mouth* has a *labrum* with a deep notch, and with three or four extremely small teeth on each side of the notch. The palpi are large, densely covered with not very long hairs. The *mandibles* have five short and blunt teeth, the undermost two of which are rudimentary. The *maxillæ* (Pl. XIII. fig. 22) have the edge straight, with a very small rounded notch behind the two greater spines; at a little distance from the inferior angle there is another large and broad spine, and, moreover, a considerable number of smaller spines between the larger ones. The *second maxillæ* are elongate, densely clothed with hairs on their anterior surface. The first pair of *cirri* has very unequal rami; the shortest has ten, the longest and anterior ramus has twenty segments. The shorter ramus has the segments very protuberant in front, and thickly clothed with spines, which are placed in tufts on the front and the hinder margins of each segment. The other cirri did not show anything very particular.

A group of about ten specimens is attached to a stone; two other specimens are attached to a branch, &c. The size of the specimens is slightly different; the largest specimen has a height of not quite 9 mm., and the greatest diameter of the base is 7 mm.

This species was taken together with specimens of *Balanus trigonus*, and with *Balanus amaryllis*, at Station 233A, May 17 to 19, 1875; lat. 34° 35′ N., long. 135° 10′ E.; depth, 8 and 50 fathoms; bottom mud, sand. Kobe, Japan.

Section F. Parietes and radii not permeated by pores; basis sometimes permeated by pores, sometimes not, and sometimes excessively thin and hardly distinguishable.

Balanus amaryllis, Darwin (Pl. VII. figs. 4, 5).

Balanus amaryllis, Darwin, Balanidæ, 1854, p. 279.

This is, according to Darwin, a distinct and well-defined species. It is characterised by the walls and radii not being permeated by poroes; by its porous basis, by the extremely narrow radii, with their quite smooth, rounded, and very oblique summits. Its scutum is striated longitudinally, its tergum has a very narrow spur. H.M.S. Challenger took specimens of this species on two occasions; once near Station 186, in

Torres Strait, the second time near Hiogo Harbour, Japan. The surface of the shell is beautifully striped with pinkish-purple; the specimens from Kobe, Japan, are darker, almost rose-coloured, and have the shell conical; those of Torres Strait are slightly more cylindrical, and have the orifice larger.

Hitherto the species was only known from the mouth of the Indus, from the East Indian Archipelago, from the Philippine Archipelago, from Moreton Bay (Australia), and from the north-east coast of Australia. So our knowledge of its distribution is slightly augmented by its being observed also in Japan.

Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; depth, 8 fathoms; bottom, coral sand. Station 233A, May 17 to 19, 1875; lat. 34° 35′ N., long. 135° 10′ E.; depth, 8 and 50 fathoms; bottom, mud and sand. Kobe, Japan.

Balanus tenuis, n. sp. (Pl. XIII. figs. 29–33).

Shell snow-white, glossy; orifice deeply toothed. Radii narrow, with their summits very oblique and slightly concave; basis solid. Scutum striated longitudinally; tergum with a short and rather broad spur.

This species, in many respects, corresponds to *Balanus amaryllis*, Darwin, and especially to the variety (*b*) of Darwin. Yet I think it is different; if we knew something about the origin of this species, we should perhaps consider it as the form which had developed from the other under the changed conditions of the deep sea. Darwin tells us that *Balanus amaryllis* was often met with attached to ships' bottoms, and as the present species was taken from 100 fathoms, we may safely call it a deep-sea species in comparison with the other.

In the collection made during the cruise of H.M.S. Challenger this species is represented by four small specimens only. The greatest diameter of the base of the largest specimen is 7·5 mm. The height of this specimen is not more than 5 mm. The *compartments* are extremely steep; hence the toothed orifice is large. This orifice has the shape of a pentagon. The different compartments are striated longitudinally, caused by the internal longitudinal ribs being visible through the transparent surface, and, though not so distinctly, also transversely. However, the surface is smooth and even glossy. The *radii* are well-developed, though narrow; their upper edges are extremely oblique. The internal surface of the compartments is very strongly ribbed. The *basis* is very thin and shows ribs also, which, however, are solid.

Scuta (figs. 30 and 32) triangular, not elongated, distinctly striated longitudinally. Internally the articular ridge reaches beyond half the tergal margin; it is rather prominent. The adductor ridge is only slightly developed; the cavity for the depressor muscle is narrow.

Terga (figs. 31 and 33) exhibit traces of longitudinal striæ. There is no longitudinal furrow, but, as in *Balanus amaryllis*, the scutal margin is distinctly curved. The valve is slightly beaked. The spur is short and not very narrow; its length equals its distance from the basi-scutal angle. The two parts of the basal margin of the tergum which are separated by the spur describe together an angle little greater than 90°. The crests for the depressors are very distinctly developed.

Mouth.—Labrum with three distinct teeth on each side of the notch. Palpi long, surface covered by numerous slender spines. *Mandibles* with five teeth, the last two of which are small. *Maxillæ* with the edge quite straight, without any step-like projection; the first two are only a little stouter, and before the lower extremity there are again two, which are a little more robust. *Second maxillæ* on their inner faces divided into a large upper and a small inner and lower lobe. The first is almost totally covered with long slender hairs, the second is only slightly hairy.

Cirri.—First pair with very unequal rami; the shortest ramus has the first segment very long, and six following segments short; the longest ramus has the first long segment indistinctly divided into six segments; moreover, it has nine segments following, which are much more slender than are the segments of the shortest ramus. The second cirrus has in both rami ten segments, which are produced on both sides. The pedicels of the second, third, and fourth cirrus are furnished with dorsal tufts of spines. The posterior cirri have segments more broad than long, bearing two pairs of nearly equally long spines, and a third pair, beneath the first two, of very small spines. Between each pair of long spines there is a small intermediate tuft. I have not found out the basi-dorsal point at the penis.

This species was taken at Station 204, November 2, 1874; lat. 12° 43′ N., long. 122° 10′ E.; depth, 100 and 115 fathoms; bottom, mud.

Observations.—This species occurs at the same locality as the nearly related *Balanus amaryllis*, viz., in the Philippine Archipelago.

Section G. Parietes not permeated by pores. Radii wanting. Basis membranous.

Balanus corolliformis, n. sp. (Pl. VI. figs. 21, 22; Pl. XIII. fig. 1–7).

Basis membranous; radii absent; parietes not permeated by pores; tergum with a very broad articular ridge; membrane lining the growth-ridges with distinct spines. Carinal and basal margins of the tergum nearly of the same length.

This is a very remarkable species, and I confess to have been long in doubt whether it was a *Balanus* or not. The investigation of specimens of a nearly related form dredged by H.M.S. "Triton" in the Faröe Channel, which showed the same characteristic differences from the other species of the genus, convinced me that I was right in consider-

ing them as representatives of a new section of the genus *Balanus*. The absence of radii, the solidity of the parietes, the membranous base, form the characteristic marks of this section, which at present comprises only two species. Both species are from rather deep water; and we need hardly doubt that the structure of the shell affords a very striking instance of the influence of their living at a more considerable depth. Being solid (not permeated by pores), the compartments have by no means the strength of other species of the genus, which, as a rule, have the compartments composed of two laminæ united by longitudinal septa; and, moreover, the strength is diminished by the absence of the radii, which in other species, as modified parts of the side of the compartments, overlap the adjoining compartments. In the present species the compartments adhere so feebly as almost to separate on being manipulated. The largest specimen of *Balanus corolliformis* which was obtained, and which, therefore, has been figured (Pl. VI. figs. 21, 22), showed the compartments quite loose from one another, and only adhering by means of the muscles which were attached to them. For an animal living near the surface, the violent beating of the waves would soon prove fatal if its walls showed the structure of our *Balanus corolliformis*. It was taken at a depth of 150 fathoms, at which depth it may be taken for granted that the water does not experience the direct influence of the beating of the waves. The other species was taken at a depth of no less than 516 fathoms.

Balanus corolliformis has to a certain degree the shape of the corolla of a flower, the orifice of the shell being much wider than its base, and being very deeply toothed. The latter character is due to the obliquity of the summits of the alæ, and to some extent also to the circumstance that the alæ are very broad at a certain distance from the base, and then slope downwards, so as to be extremely narrow at the base of the shell. In the largest specimen of this species which was collected, the width of the shell, which is very considerable at the orifice, grows smaller downward, but remains the same almost from the middle to the base. The growth-ridges run regularly nearly parallel in the upper half of the shell, and much more irregularly in the under half. As in some of the cases in which the radii are not developed, mentioned by Darwin, the sutures of the valves in the lower half of the shell at least are marked only by fissure-like lines. The sheath extends one-third down the shell; the rostrum, which, seen from the exterior, does not show a trace of radii, has, when seen from the interior, the sheath divided into three parts, of which the two lateral portions may be considered as rudimentary radii. The rostrolateral compartment and the extremely narrow carino-lateral compartment show also on the inner side traces of what might be considered a radius.

Colour of the shell dirty white; the limits of the growth-ridges are coloured yellowish by the persistence of the membrane, which is distinctly hairy. The hairs are short, stiff, chitinous spines. At different places the surface is irregularly invested by calcareous masses of a Polyzoon. Of the smaller specimens some are attached to the spines of an

Echinid, and these have very narrow bases; the larger specimens, however, have a circular base, and are found attached to stones. The base is very thin, membranous.

The opercular valves are united together, and to the shell by strong membrane of a light yellowish colour. The exterior surface of the valves is totally hidden by a thick hairy chitinous membrane. The shape of the *scutum* (Pl. XIII. figs. 2 and 3) is very peculiar. The growth-ridges are very broad and distinct in the superior half of the valve, they are very narrow and only slightly developed in the inferior half. The valve is distinctly bowed, so that the outer side is concave. The occludent margin is slightly inflected, the basal margin is convex, the tergal margin describes a bow. Internally the articular ridge is well-developed, and there is also a pit marked by a slight ridge for the reception of the lateral depressor muscle. The occludent margin is internally strengthened by a well-developed ridge, which runs along the whole margin, but which is especially developed near the basal margin. The cavity for the adductor muscle is hardly visible. The *tergum* (Pl. XIII. figs. 1 and 4) is also slightly bowed, hence concave at the outer side. The apex is pointed and almost imperceptibly beaked. Its scutal margin is long and straight; it is separated by a narrow ridge from the shallow furrow, which runs almost from the apex down to the extremity of the spur. The occludent margin is convex, and only little shorter than the nearly straight basal margin. The spur is not very distinct, and runs almost to the basi-scutal angle of the valve. Internally the valve is well marked by the very strong development of its articular ridge, which from the apex extends almost to the middle of the scutal margin, and which, when seen from the exterior side, projects very considerably beyond the scutal margin of the valve. The crests for the depressors are not very prominent.

The size of the largest specimen is 45 mm. from the tip of the opercular valves to the base. The distance between the apices of the rostrum and carina is about 29 mm. The greatest diameter of the base is 16 mm.

The structure of the *mouth* is in many respects very remarkable. The edge of the *labrum* (Pl. XIII. fig. 5) is not furnished with teeth, but is bordered by extremely minute hairs. What is much more interesting is that it is not notched at all, whereas Darwin says that it is always notched in this genus. The palpi are robust and very long, with their apices almost touching each other. Their surface is furnished with very numerous curled spines, which are not smooth, but in their turn are furnished with very small hairs. The *mandibles* (fig. 6) have four teeth, and the inferior angle is divided into three very small teeth, the first of which is laterally bordered by some extremely small teeth. The distance between the first two teeth of the mandible is greater than that between the following ones. The *maxillæ* (fig. 7) show a small quadrilateral notch behind the two larger upper spines; the part below the notch is slightly projecting, and is furnished with numerous densely crowded spines of nearly the same size. The pair of lower spines larger than the others, which is present on the maxilla of most other species of *Balanus*,

is wanting in the present species. The *outer maxillæ* have the ordinary shape, their inner faces being rather indistinctly divided into two lobes.

Cirri.—The rami of the first pair are only very slightly unequal; both have fourteen segments, but the anterior ramus is slightly longer, because the segments themselves are a little longer. The breadth of the two rami is nearly equal; the anterior surface of each segment is produced in both rami; the projections bear a tuft of spines on their summit. The rami of the second pair are unequal as far as the number of segments is concerned; this is seventeen in the shortest, and twenty-three in the longest ramus. The segments, and especially the lower ones, are produced; the projections thus formed are crowned by a tuft of spines. The rami of the third cirrus have respectively twenty-five and twenty-eight segments. The lower segments are produced on their anterior surface. The three anterior pairs are much shorter than the three posterior ones; whereas the former three are straight or only slightly bowed, the latter are distinctly curled. The number of the segments is much more considerable, and is in the fourth pair thirty-two and thirty-seven. The number of spines on each segment is two, three, or four pairs, two on the upper, three on the middle, four on the lower segments, small spines being inserted between the larger ones in a not very regular way. The undermost part of the pedicels of the four anterior cirri is much swollen, and projects as a kind of vesicle beyond the surface of the animal's body.

The *penis* is long and only indistinctly hairy; but, whilst it is rather thick near the under extremity, it grows very slender at the other end.

This species lives attached to pebbles and also to the spines of a *Cidaris*. The latter specimens are a great deal smaller than those which were found attached to pebbles. Six specimens were taken, only two of which were of considerable size. *Scalpellum recurvirostrum*, n. sp., was procured with the same haul of the dredge. This was at Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; depth, 150 fathoms, bottom temperature, 1°·8 C.; bottom, rock.

For the differences between this and next species, *vide* under the same.

Balanus hirsutus, n. sp. (Pl. XIII. figs. 8–15).

Basis membranous; radii absent; parietes not permeated by pores; articular ridge of the tergum broad, but not extending so far downwards as in *Balanus corolliformis*. Carinal margin of the tergum much shorter than the basal margin. Membrane lining the growth-ridges with distinct spines.

Balanus hirsutus and *Balanus corolliformis* are two nearly related species, corresponding in all essential respects. I must consider them, however, as different species, because their shape is quite different, and in the second place, because the tergum shows very striking differences also.

Though also furnished with a deeply toothed orifice, the shape of the shell in this species is much more regularly tent-like than in the foregoing species. It is represented by two specimens only, one of which is attached to the spine of an *Echinus;* this specimen is unsymmetrically flattened, and has an elongate but very narrow base; its orifice is large, which is caused by the perpendicular condition of the compartments; the other specimen is attached laterally to the rostrum and the rostro-lateral compartment of the first; this latter specimen has a very regular shape and a broad circular base, which is large in comparison with the orifice of the shell.

Scutum (figs. 10 and 11) and *tergum* (figs. 9 and 12) resemble very much the same valves of *Balanus corolliformis;* the basal margin of the scutum—especially towards the basi-tergal angle—is much more rounded than in the other species. The tergum is more elongate in the direction from apex to spur; hence the basal is much longer than the carinal margin. The strongly-developed and broad articular ridge does not reach half way to the scutal margin (as in *Balanus corolliformis*), but only reaches along the first third of the scutal margin; the crests for the attachment of the depressor muscle are more distinct than in the other species.

The valves are not covered by a thick woolly membrane, as was the case in the foregoing species; the growth-ridges are bordered by yellow membrane, which is hairy, as in the case of the compartments. The size of the specimens of this species is by no means so considerable as in the foregoing species. The flattened specimen attached to the *Echinus* spine is only 15·5 mm. high; the greatest diameter of the narrow base is only 13·5 mm. The smallest specimen shows a base of 11 mm. diameter, and but a height of 9·5 mm.

The structure of the *mouth* is much like the same part of *Balanus corolliformis.* The *labrum* (fig. 13) does not present differences, except in being much shorter; the *mandibles* (fig. 14) have the fourth teeth very small, and almost forming a part of the step-like process at the inferior angle. The *maxillæ* (fig. 15) are exactly the same; at least one of them, for the two of the same specimen are not quite equal, the one having a much wider notch behind the great upper spines than the other. The *outer maxillæ* present no differences.

The cirri are in all respects formed after the same type as in *Balanus corolliformis;* however, there are little differences in the number of the segments as well as in that of the spines. So the first pair has also two equal rami, which, however, have eleven segments. These details are, however, of no importance, as the specimen, the animal of which I dissected, was the smaller of the two, and probably not quite full-grown.

This species was taken during the cruise of H.M.S. "Triton," at Station No. 10 ("Triton" cruise), August 24, 1882; lat. 59° 40′ N., long. 7° 21′ W.; depth, 516 fathoms; bottom, mud; temperature, 46° to 46°·5.

Observation.—This is the first instance of a species of *Balanus* being taken at so considerable a depth as upwards of 500 fathoms.

Acasta, Leach, 1817.

This genus comprises those sessile Cirripedia which have six compartments, the parietes and basis of which are not porous, and the basis of which is calcareous, cup-formed, not elongated, and attached to sponges, or rarely to the outer layer of the stalk of *Isis*. Darwin describes nine species as belonging to this genus, which are found all over the world. In the Challenger collection I found one of these species represented by a single specimen. It is—

Acasta fenestrata, Darwin.

Acasta fenestrata, Darwin, Balanidæ, 1854, p. 316.

This species differs from the other species of the genus in the large membrane-covered openings between the compartments above the basal cup. The carino-lateral parietes are half as broad as the lateral parietes. The smoothness of the basal edges of the parietes and of the edge of the cup, and the structure of the tergum, with its short and prominent articular ridge and pointed spur, has not been investigated, as I did not wish to sacrifice the only specimen. The form of the deep basal cup downwards ending in a blunt point, slightly curved to one side, answers precisely to the description and figure of Darwin. The only specimen was taken in the Philippine Archipelago.

The specimen is 9 mm. in height, being smaller than those observed by Darwin, the largest of which was 0·6 inches (15 mm.) in height.

Station 208, January 17, 1875; lat. 11° 37′ N., long. 123° 32′ E.; depth 18 fathoms; bottom, mud.

Tetraclita, Schumacher, 1817.

This genus comprises those sessile Cirripedia which have four compartments, sometimes externally calcified together; parietes are permeated by pores, generally forming several rows. The basis is flat, irregular, calcareous, or membranous. The difference between the genus *Balanus* and the present genus consists mainly in the absence of the carino-lateral compartments, and in the numerous rows of parietal pores, *Tetraclita rosea* being the only species with but a single row. As the description Darwin gives of this genus is very elaborate, and as our knowledge has not been considerably augmented since the publication of that description, I think it is of no use to enter into details about it.

The genus comprises eight species, two of which, *Tetraclita rosea*, Krauss, sp., and *Tetraclita coerulescens*, Spengler, sp., are represented in the Challenger collection. For the determination of the species I have composed the following table :—

Tetraclita.

I. Parietes formed by a single row of large tubes, . .	*Tetraclita rosea*, Krauss, sp.
II. Parietes formed by numerous rows of tubes.	
1. Tergum with the spur joined to the basi-scutal angle.	
(*a*) Basis membranous, ...	*Tetraclita purpurascens*, Wood, sp.
(*b*) Basis thin, calcareous.	
α Radii broad, ...	*Tetraclita costata*, Darwin.
β Radii narrow or absent.	
(*α*) Surface of the shell corroded, . .	*Tetraclita porosa*, Gmelin, sp.
(*β*) Surface of the shell with narrow, serrated ribs, ...	*Tetraclita serrata*, Darwin.
2. Tergum with the spur not joined to the basi-scutal angle.	
(*a*) Basis thick, calcareous, ...	*Tetraclita radiata* (Blainville) Darwin.
(*b*) Basis very thin, articular ridge of the scutum very prominent, ...	*Tetraclita coerulescens*, Spengler, sp.
(*c*) Basis very thin, articular ridge of the scutum not very prominent, ...	*Tetraclita vitiata*, Darwin.

Tetraclita rosea, Krauss, sp.

Conia rosea, Krauss, Die südafrikanischen Mollusken, 1848.
Tetraclita rosea, Darwin, Balanidæ, 1854, p. 335.

Two specimens of this species were taken in Sydney Harbour (Port Jackson). The two specimens are of a somewhat different size; the larger one measures 31 mm. across the base, a size a little greater than Darwin says it has (1·1 inch). This species was taken from a depth of six fathoms. It must have been very near the surface, for in Australia this species lives attached to littoral rocks and shells.

Tetraclita coerulescens, Spengler, sp. (Pl. XIII. fig. 34).

Lepas coerulescens, Spengler, Skrifter af Selsk., I. 1790.
Tetraclita coerulescens, Darwin, Balanidæ, 1854, p. 342.

H.M.S. Challenger, when at Zamboanga (the most south-western point of Mindanao, Philippines), took some specimens of this species at a depth of 10 fathoms. As there existed differences between these specimens and the description and figures of Darwin, I first thought of describing them as belonging to a different, though nearly related,

species. A close examination, however, brought to light that in most other respects the Zamboanga specimens closely resembled the species as described by Darwin, and so I determined to class them with that species.

General appearance, colour, form of the shell, and structure of the compartments as described by Darwin. Size smaller; the largest specimen Darwin observed was 45 mm. in basal diameter, and the largest specimen from Zamboanga measures only 31 mm. The scutum is much like that described by Darwin, but the tergum has, in the first place, the scutal margin very coarsely toothed; and in the second place, its articular ridge, which, according to Darwin, is not prominent, is very prominent indeed, and therefore resembles much more the same valve in *Tetraclita radiata*. I have figured this valve (Pl. XIII. fig. 34). I almost feel sure that Darwin, had he known the specimens collected at Zamboanga, would have proposed only one species, instead of the two nearly related ones—*Tetraclita coerulescens*, Spengler, sp., and *Tetraclita radiata*, de Blainville, sp. And it is this consideration which has withheld me from describing the Challenger specimens as a third distinct species.

To one of the specimens a *Balanus* was attached, which was still young, and probably belongs to one of the varieties of *Balanus amphitrite*, Darwin. The adductor ridge at the internal side of the scutum, however, was not very distinctly developed.

The specimens of *Tetraclita coerulescens* were taken at Zamboanga, October 23, 1874, from a depth of 10 fathoms.

Coronula, Lamarck, 1802.

This genus comprises those sessile Cirripedia which have six compartments of equal sizes, and thin, deeply folded walls, with the folds forming cavities open only on the under side of the shell; their opercular valves are much smaller than the orifice of the shell.

Of this genus Darwin knew three living species: *Coronula balaenaris*, Gmelin, sp., attached to whales in the Southern Ocean; *Coronula diadema*, Linn., sp., of the Northern Atlantic Ocean; *Coronula reginæ*, Darwin, attached to whales in the Pacific Ocean. They may be distinguished from one another in the following way:—

Coronula.

I. Ribs of the compartments flattened.
  1. Radii very thick, opercular valves four, . . . *Coronula balaenaris*, Gmelin, sp.
  2. Radii thin, terga absent, ... *Coronula reginæ*, Darwin.

II. Ribs of the compartments convex, ... *Coronula diadema*, Linn., sp.

Coronula diadema is the only species which is represented in the collection made during the cruise of H.M.S. Challenger.

Coronula diadema, Linn., sp.

Lepas diadema, Linnæus, Systema Naturæ, 1767.
Coronula diadema, Darwin, Balanidæ, 1854, p. 417.

This is a very common and very characteristic species, for which Darwin gives the following diagnosis :—the shell is crown-shaped, with longitudinal convex ribs, having their edges crenated; the orifice is hexagonal; the radii are moderately thick and very broad; the terga are absent or rudimentary. The Challenger collected a single set of specimens when at Bermuda in April 1873. They are small specimens, the largest of the seven having a diameter of only 24 mm.

With regard to the geographical distribution of this species, Darwin, who knew only four specimens with certain localities attached to them, suspected that it would only occur in the northern seas, *Coronula reginæ* replacing it in the Pacific. I have not been able to find out whether this opinion is universally admitted at present. I believe, however, that it is somewhat erroneous. Darwin himself found in the British Museum a specimen among some shells of Mollusca from New Zealand, but he does not attach much importance to this single instance, as an animal procured from a floating whale in the early part of a voyage might so easily be sent home with specimens subsequently collected in another region. In the Royal Natural History Museum of the Netherlands at Leyden, there is, however, a single specimen of this species labelled " v. Siebold, Japan," and I think that we have no right to doubt the correctness of this label. This specimen is, moreover, very interesting on account of its great size; its basal diameter is 78 mm., whereas the largest specimen that Darwin saw was only $2\frac{1}{2}$ inches in diameter (63·5 mm.). In 1881, the Dutch schooner " Willem Barents " collected a specimen of this species at Vardö, which has about the same dimensions as the specimen from Japan.

Chthamalus, Ranzani, 1820.

This genus comprises those sessile Cirripedia which have six compartments, a membranous basis, which sometimes (*Chthamalus hembeli*, Conrad, sp.) is calcareous in appearance, owing to the inflected parietes. It is the only genus of the Sub-Family of Chthamalinæ, Darwin, which was instituted for those Balanidæ in which the rostrum has alæ but no radii, in which the rostro-lateral compartments are without alæ on either side, and which have no porous parietes.

All the species of this genus seem to be littoral; at least Darwin says that this is the case with all the species of whose habits he knows anything, and I do not believe that in this respect our knowledge has been increased since the publication of his monograph. Owing probably to their littoral habits, Darwin does not believe that any species of the genus has hitherto been found fossil. Whether these two facts stand really

in so near a relation to one another as Darwin suggests, I am inclined to doubt; nevertheless it is true that we do not know a single fossil representative of this genus.

What the Challenger collected as representatives of this genus is of no consequence. I have, however, been obliged to describe one of the two species which the collection contained as new to science. According to Darwin this genus comprises eight species; two new species were proposed by Frey and Leuckart for two forms which they considered as different from *Chthamalus stellatus*, and which were found at Heligoland. I think, however, they are only varieties of the true *Chthamalus stellatus* as described by Darwin.

The species of this genus may be determined with the aid of the following table :—

Chthamalus.

I. Scutum and tergum completely calcified together, . . . *Chthamalus intertextus*, Darwin.
II. Scutum and tergum not calcified together.
  i. Tergum with a deep narrow pit for the depressor muscle, . *Chthamalus scabrosus*, Darwin.
  ii. Tergum without a deep pit for the depressor muscle.
    (*a*) Scutum with two or three furrows extending down to the middle of the valve, ... *Chthamalus hembeli*, Conrad, sp.
    (*b*) Scutum without furrows.
      α Tergum with the carinal margin protuberant.
        (i.) Sutures of the walls formed by interlocking teeth. Tergum not elongate, . . *Chthamalus dentatus*, Krauss.
        (ii.) Sutures of the walls not formed by interlocking teeth. Tergum elongate, . . *Chthamalus challengeri*, n. sp.
      β Tergum with the carinal margin not protuberant.
        (i.) Radii with the sutural edges quite smooth, . *Chthamalus antennatus*, Darwin.
        (ii.) Radii with the sutural edges crenated.
          1. Terga triangular, equilateral; orifice of the shell much elongated, . . . *Chthamalus fissus*, Darwin.
          2. Terga not equilateral; orifice not elongated.
            (1) Membrane lining the sheath, and the opercular valves fimbriated, . *Chthamalus cirratus*, Darwin.
            (2) Membrane lining the sheath, and the opercular valves not fimbriated, . *Chthamalus stellatus*, Poli, sp.

Chthamalus dentatus, Krauss.

Chthamalus dentatus, Krauss, Die südafrikanischen Mollusken, 1848.
Chthamalus dentatus, Darwin, Balanidæ, *loc. cit.*, p. 163.

This species has the shell white or brownish, sutures between the valves formed by interlocking teeth; the tergum has a protuberant carinal margin. I refer to it some very small specimens of *Chthamalus*, which are imbedded in the corroded surface of the large specimens of *Balanus tintinnabulum*, taken at St. Vincent Harbour, Cape Verde Islands.

The specimens have irregularly folded walls, with the surface corroded and entirely covered by the calcareous coating of the *Balanus;* they are so totally embedded in this calcareous layer, that their surfaces only appear when the lime is removed. The orifice of the shell, with the indistinctly visible opercular valves, betrays the presence of this Cirriped. The opercular valves also have the surface corroded and disintegrated; having been isolated and cleansed as far as possible (boiled with caustic potash, &c.) it is possible to judge of their form; in general it is much the same as described by Darwin. The tergum not only corresponds to the specimens of Darwin because of the very prominent articular ridge, but also because of the arched and protuberant carinal margin.

This species inhabits the coast of south Africa and Natal, of west Africa, Loanda, and the Gold Coast. The Cape Verde Islands must now be added as a new locality. Darwin saw a specimen from the West Indies, but it was the variety which so commonly adheres to ships' bottoms.

July 1873, 7 to 20 fathoms; St. Vincent Harbour, Cape Verde Islands.

Chthamalus challengeri, n. sp. (Pl. XIII. figs. 35–38).

Shell white, thin, brittle; surface smooth, irregularly folded; sutures between the valves distinct. Tergum with an arched and protuberant carinal margin, elongate in the direction of the spur.

I propose this new name for a species of the genus *Chthamalus* of small size, which was taken from the screw of H.M.S. Challenger. There is a considerable number of specimens, the greater part of which have an irregular cylindrical shape. I think they are all of the same age, and as some of them are furnished with eggs, they are probably quite or at least very nearly full-grown. The cylindrical specimens form, as a rule, groups, being attached to one another by their lateral compartments. The other specimens have a flattened conical shape; they are either isolated or associated in groups; in the latter case, however, they adhere to one another only by the basal edges of their compartments. Often, but most obviously so in the cylindrical specimens, the basal margin is continued into a ledge, which, however, is not inflected inwards but outwards. In the flat-conical specimens the surface of the parietes is almost totally smooth, and in them folds are only visible near the basal margin; hence in these specimens the basal edge is sinuous. The cylindrical specimens distinctly show that they were in the beginning flat-conical, like the other specimens. The cylindrical lower part of the shell is often narrower than the upper part. In these specimens the walls are almost flat in the lower half, but irregularly folded in the upper half. The radii in all the specimens are very narrow, their sutural edges are not at all crenated; the alæ are broad, their upper edges are only slightly oblique. In all the specimens the sutures are distinctly visible.

The *scuta* (Pl. XIII. fig. 37) are triangular, but the tergal margin is much shorter than the other margins; the depression for the adductor muscle is not very deep, but the articular ridge is very prominent and has an arched edge. The *terga* (Pl. XIII. fig. 38) are elongate, rather narrow. The spur is not very distinctly developed. The crests for the depressor muscles cannot be said to descend beneath the basal margin of the valve. The articular ridge is strongly sinuous, but it is also very prominent. The carinal margin is distinctly arched.

Of the animal itself I will only give details with regard to the structure of the mouth and the first two cirri. The crest of the *labrum* is not only hairy, but there are also some fine teeth. The *palpi* are very broad and stout, and bear a great number of hairs, which are placed along both margins, and also on the exterior surface; the hairs are different in length, but they have almost the same thickness. The *mandibles* have three normal teeth; the fourth is divided into two parts, and is situated immediately in front of the pectinated inferior angle. At the inferior extremity of this angle a slightly stronger tooth is visible. The *maxillæ* have three larger spines above the notch and three smaller ones on the upper margin of the notch. Behind the notch a row of spines is visible, the posterior ones being smaller than the anterior. The *second maxillæ* show a terminal lobe and a lower lobe, both furnished with numerous spines. The *first pair* of *cirri* has six segments in both rami; the *second pair* six segments in the one and eight in the other ramus; both cirri have the front margin of the rami covered with numerous spines, the hinder margin being furnished with tufts of spines at the extremity of the segments.

This species was taken in the Pacific, September 2, 1875, from the screw of H.M.S. Challenger. (About Station 269, lat. 5° 54′ N., long. 147° 2′ W.) The Challenger left Yeddo (Japan) about the middle of June, after a stay of more than a month in the waters of Japan. Probably the specimens attached themselves in the Cypris-stage to the screw when the vessel was there.

This species is no doubt nearly related to *Chthamalus stellatus*, Poli, sp., and also to *Chthamalus antennatus*, Darwin. The difference is, I think, in the form of the opercular valves, which in the two above-named species, according to Darwin, are hardly distinguishable from one another. In the present species the articular ridge of the scutum is much more prominent, and besides, the form of the tergum is much more elongate. On account of its carinal margin being protuberant, it resembles *Chthamalus dentatus*, Krauss, but in consequence of the slightly-pointed and depending basi-carinal angle it is perhaps also related to *Chthamalus cirratus*, Darwin. Many of the so-called species of this genus resemble one another so much that one almost feels inclined to doubt the correctness of Darwin's opinion when he considers them as so many different species. It is, however, possible that a close examination of the groups of specimens which Darwin had at his disposal would convince us, on the other hand, that the great naturalist was right in the present case also.

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PLATE I.

PLATE I.

Figs. 1, 2. *Lepas anatifera*, Linn.

Fig. 1. Body, with the left hand scutum and tergum taken away; natural size. *sc.*, right hand scutum; *t.*, right hand tergum; *ca.*, carina; *x.*, membrane; *ma.*, part of the membrane which has been attached to left hand scutum; *m.*, parts of the mouth; c^1, first cirrus.

Fig. 2. Mouth and first cirrus of the left side; magnified 5 diameters. *ma.*, *m.*, c^1 as in fig. 1; f^1 and f^2, filamentary appendages; *p.*, penis; *ovd.*, oviduct; *ga.*, female genital aperture.

Fig. 3. *Lepas hillii*, Leach, sp.

Fig. 3. Mouth and basal articulations of the first three cirri; magnified 6 diameters. *m.*, mouth; f^1, f^2, and f^3, filamentary appendages; c^1, c^2, and c^3, first, second, and third cirrus.

Fig. 4. *Lepas anserifera*, Linn.

Fig. 4. Basal articulation of the first cirrus; magnified 6 diameters. f^1, f^2, f^3, and f^4, filamentary appendages.

Figs. 5–7. *Lepas fascicularis*, Ellis and Sol.

Fig. 5. Mandible; magnified 41 diameters.

Fig. 6. Maxilla; magnified 41 diameters.

Fig. 7. Basal articulation of the first cirrus; magnified 6 diameters. f^1, f^2, f^3, f^4, and f^5, filamentary appendages.

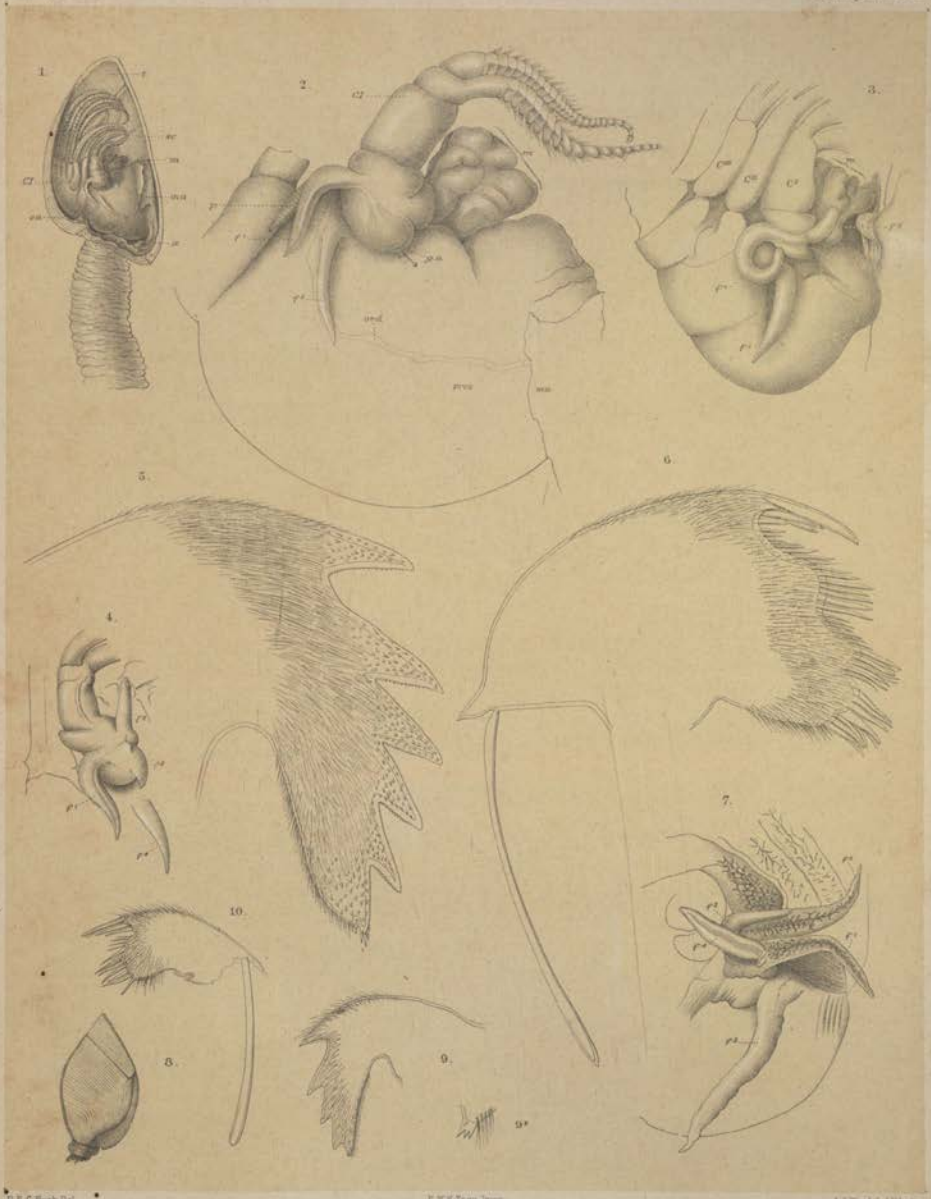
Figs. 8–10. *Pœcilasma carinatum*, n. sp.

Fig. 8. Animal, lateral view; magnified 2 diameters.

Fig. 9. Mandible; magnified 41 diameters.

Fig. 9*. Inferior angle of the mandible; magnified 270 diameters.

Fig. 10. Maxilla; magnified 41 diameters.



P. F. C. Hoek Del. F. W. K. Troy Impr. A. J. Wendel, Lithogr.

1-2 LEPAS ANATIFERA. 3 L. HILLII. 4 L. ANSERIEERA. 5-7 L. FASCICULARIS.
8-10 POECILASMA CARINATA, n. sp.

PLATE II.

PLATE II.

Fig. 1. *Pœcilasma carinatum*, n. sp.

Fig. 1. Body taken out of the shell, with an egg-mass; magnified 6 diameters.

Figs. 2–4. *Pœcilasma gracile*, n. sp.

Fig. 2. Animal, lateral view; magnified 6½ diameters.
Fig. 3. Labrum (*la.*), with palpi (*pa.*); magnified 94 diameters.
Fig. 4. Mandible; magnified 94 diameters.
Fig. 4*. Inferior angle of the mandible; magnified 270 diameters.

Figs. 5–9. *Megalasma striatum*, n. gen., n. sp.

Fig. 5. Animal, lateral view; magnified 6½ diameters.
Fig. 6. Animal, seen from the carinal side; magnified 6½ diameters.
Fig. 7. Mouth; magnified 94 diameters. *la.*, labrum; *pa.*, palpi; *man.*, mandible; *max*^{1}., first maxilla; *max*^{2}., second maxilla.
Fig. 8. Mandible; magnified 63 diameters.
Fig. 8*. Inferior angle of the mandible; magnified 200 diameters.
Fig. 9. First cirrus; magnified 28 diameters.

Figs. 10–12. *Dichelaspis sessilis*, n. sp.

Fig. 10. Animal, lateral view; magnified 6½ diameters.
Fig. 11. Mandible; magnified 63 diameters.
Fig. 12. Maxilla; magnified 63 diameters.

Figs. 13–15. *Conchoderma virgatum*, var. *chelonophilus*, Leach.

Fig. 13. Animal, lateral view; magnified 5 diameters.
Fig. 14. Left hand mandible; magnified 41 diameters.
Fig. 15. Right hand mandible of the same animal; magnified 41 diameters.

P.P.C. Hoek Del. P.W.M. Trap Impr. A.J. Wendel Lithogr.

1 POECILASMA CARINATA, n. sp. 2-4 P. GRACILIS, n. sp. 5-9 MEGALASMA STRIATA, n. gen., n. sp.
10-12 DICHELASPIS SESSILIS, n. sp. 13-15 CONCHODERMA VIRGATA, var. CHELONOPHILUS, Leach.

PLATE III.

PLATE III.

Figs. 1–5. *Alepas pedunculata*, n. sp.

Fig. 1. Animal, lateral view; magnified 2 diameters.
Fig. 2. Mandible, magnified 63 diameters.
Fig. 3. Maxilla; magnified 63 diameters.
Fig. 4. First cirrus; magnified 13 diameters.
Fig. 5. Sixth cirrus, caudal appendage, and penis; magnified 13 diameters.

Fig. 6. *Scalpellum stroemii*, Sars.

Fig. 6. Animal, lateral view; magnified 5 diameters.

Figs. 7, 8. *Scalpellum carinatum*, n. sp.

Fig. 7. Animal, lateral view; magnified 2 diameters.
Fig. 8. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 9, 10. *Scalpellum japonicum*, n. sp.

Fig. 9. Animal, lateral view; magnified 2 diameters.
Fig. 10. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 11, 12. *Scalpellum recurvirostrum*, n. sp.

Fig. 11. Animal, lateral view; magnified 2 diameters.
Fig. 12. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 13, 14. *Scalpellum compressum*, n. sp.

Fig. 13. Animal, lateral view; natural size.
Fig. 14. Animal, seen from the carinal side; natural size.

Figs. 15, 16. *Scalpellum parallelogramma*, n. sp.

Fig. 15. Animal, lateral view; magnified 2 diameters
Fig. 16. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 17, 18. *Scalpellum triangulare*, n. sp.

Fig. 17. Animal, lateral view; magnified 3 diameters.
Fig. 18. Animal, seen from the carinal side; magnified 3 diameters.

Fig. 19. *Scalpellum acutum*, n. sp.

Fig. 19. Animal, lateral view; magnified 6½ diameters.

Figs. 20, 21. *Scalpellum album*, n. sp.

Fig. 20. Animal, lateral view; magnified 2 diameters.
Fig. 21. Animal, seen from the carinal side; magnified 2 diameters.

Fig. 22. *Scalpellum brevecarinatum*, n. sp.

Fig. 22. Animal, lateral view; magnified 6½ diameters.

Fig. 23. *Scalpellum nymphocola*, n. sp.

Fig. 23. Animal, lateral view; magnified 3 diameters.

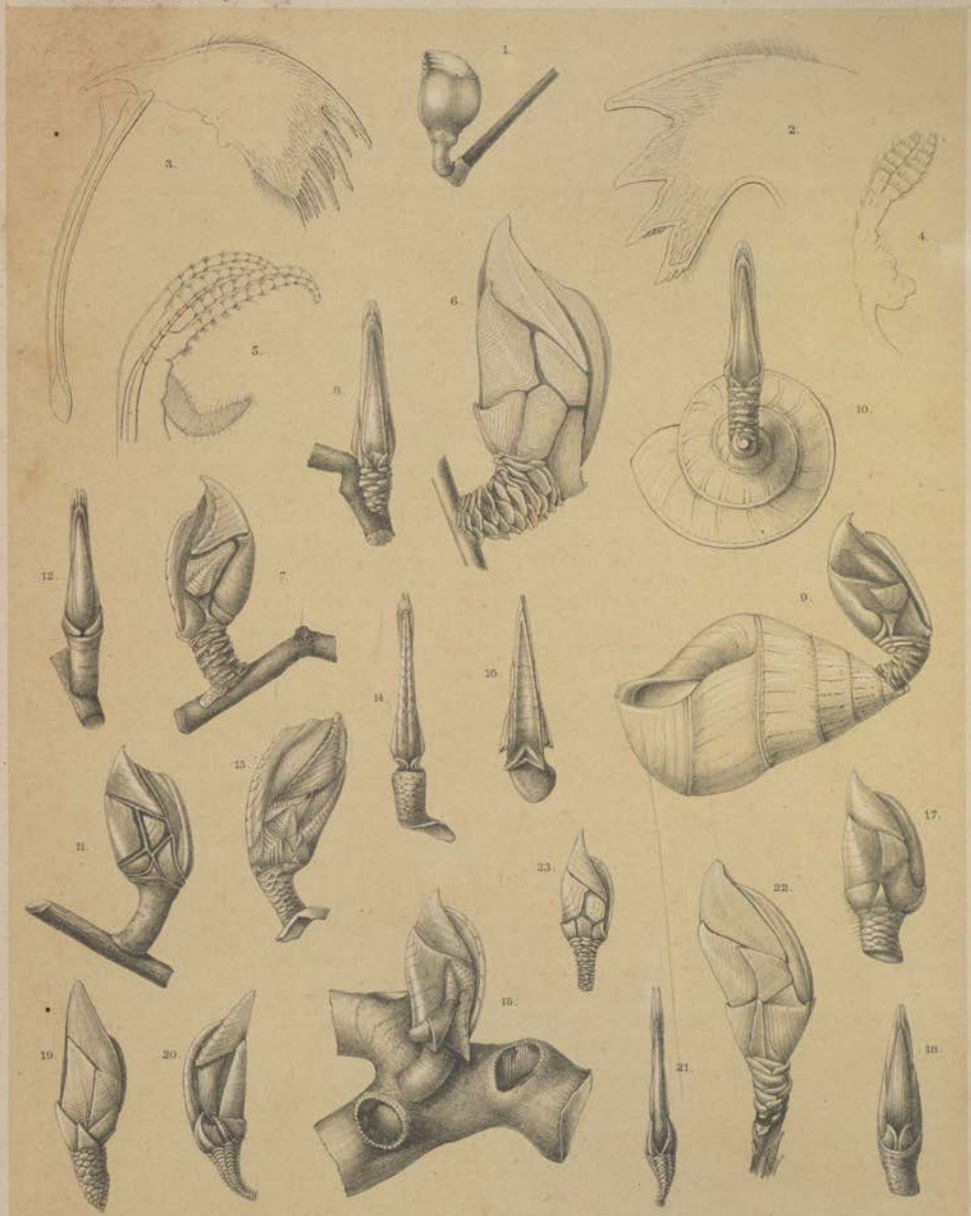


Fig. 1-6, 19 & 22 F.F.C. Hoek Cet. A.G. Drechsler Del. P.W.M. Tray Impr. A.J. Wendel, Lithogr.

1-5 ALEPAS PEDUNCULATA, n. sp. 6 SCALPELLUM STRÖMII, Sars. 7-8 SC. CARINATUM, n. sp. 9-10 SC. JAPONICUM, n. sp.
11-12 SC. RECURVIROSTRUM, n. sp. 13-14 SC. COMPRESSUM, n. sp. 15-16 SC. PARALLELOGRAMMA, n. sp. 17-18 SC. TRIANGULARE, n. sp.
19 SC. ACUTUM, n. sp. 20-21 SC. ALBUM, n. sp. 22 SC. BREVECARINATUM, n. sp. 23 SC. NYMPHOCOLA, n. sp.

PLATE IV.

PLATE IV.

Figs. 1, 2. *Scalpellum gigas*, n. sp.

Fig. 1. Animal, lateral view; natural size.
Fig. 2. Animal, seen from the carinal side; natural size.

Figs. 3–5. *Scalpellum regium* (Wyv. Thoms.) n. sp.

Fig. 3. Young animal, lateral view; natural size.
Fig. 4. Full grown animal, lateral view; natural size.
Fig. 5. Full grown animal, seen from the carinal size; natural size.

Figs. 6, 7. *Scalpellum eximium*, n. sp.

Fig. 6 Animal, lateral view; natural size.
Fig. 7. Animal, seen from the carinal side; natural size.

Figs. 8, 9. *Scalpellum elongatum*, n. sp.

Fig. 8. Animal, lateral view; natural size.
Fig. 9. Animal, seen from the carinal side; natural size

Figs. 10, 11. *Scalpellum velutinum*, n. sp.

Fig. 10. Animal, lateral view; natural size.
Fig. 11. Animal, seen from the carinal side; natural size.

Figs. 12, 13. *Scalpellum planum*, n. sp.

Fig. 12. Animal, lateral view; magnified 2 diameters.
Fig. 13. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 14, 15. *Scalpellum dubium*, n. sp.

Fig. 14. Animal, lateral view; magnified 2 diameters.
Fig. 15. Animal, seen from the carinal side; magnified 2 diameters

Figs. 16, 17. *Scalpellum antarcticum*, n. sp.

Fig. 16. Animal, lateral view; natural size.
Fig. 17. Animal, seen from the carinal side; natural size.

Fig. 18. *Scalpellum rubrum*, n. sp.

Fig. 18. Animal, lateral view; magnified 6½ diameters.

Fig. 19. *Scalpellum hirsutum*, n. sp.

Fig. 19. Animal, lateral view; magnified 6½ diameters.

Figs. 20, 21. *Scalpellum tenue*, n. sp.

Fig. 20. Animal, lateral view; magnified 2 diameters.
Fig. 21. Animal, seen from the carinal side; magnified 2 diameters

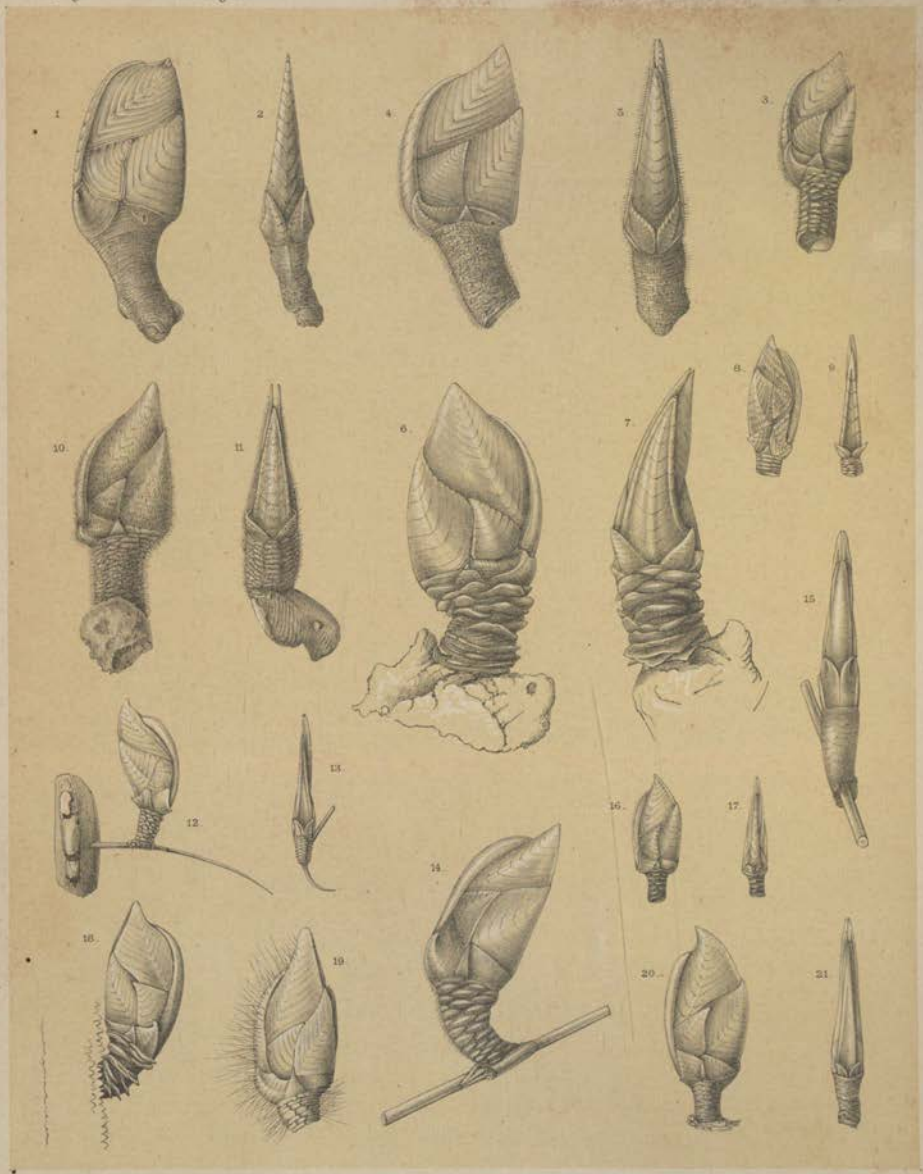


Fig. 18 & 19 P.P.C. Hoek Del. A. C. Drechsler Del. F. W. M. Trap Impr. A. J. Wendel, Lithogr.

1-2 SCALPELLUM GIGAS, n. sp. 3-5 SC. REGIUM, Wyv. Thomson. 6-7 SC. EXIMIUM, n. sp. 8-9 SC. ELONGATUM, n. sp. 10-11 SC. VELUTINUM, n. sp. 12-13 SC. PLANUM, n. sp. 14-15 SC. DUBIUM, n. sp. 16-17 SC. ANTARCTICUM, n. sp. 18 SC. RUBRUM, n. sp. 19 SC. HIRSUTUM, n. sp. 20-21 SC. TENUE, n. sp.

PLATE V.

PLATE V.

Figs. 1, 2. *Scalpellum darwinii*, n. sp.

Fig. 1. Animal, lateral view; natural size.
Fig. 2. Animal, seen from the carinal side; natural size.

Figs. 3, 4. *Scalpellum moluccanum*, n. sp.

Fig. 3. Animal, lateral view; natural size.
Fig. 4. Animal, seen from the carinal side; natural size.

Figs. 5, 6. *Scalpellum regium* (Wyv. Thoms.), n. sp., var. *ovale*.

Fig. 5. Animal, lateral view; natural size.
Fig. 6. Animal, seen from the carinal side; natural size.

Figs. 7, 8. *Scalpellum novæ-zelandiæ*, n. sp.

Fig. 7. Animal, lateral view; magnified 6 diameters.
Fig. 8. Animal, seen from the carinal side; magnified 6 diameters.

Figs. 9, 10. *Scalpellum tritonis*, n. sp.

Fig. 9. Animal, lateral view; magnified 6 diameters.
Fig. 10. Animal, seen from the carinal side; magnified 6 diameters.

Fig. 11. *Scalpellum australicum*, n. sp.

Fig. 11. Animal, lateral view; magnified $3\frac{1}{2}$ diameters.

Fig. 12. *Scalpellum minutum*, n. sp.

Fig. 12. Animal, lateral view; magnified 6 diameters.

Fig. 13. *Scalpellum truncatum*, n. sp.

Fig. 13. Animal, lateral view; magnified 5 diameters.

Fig. 14. *Scalpellum vitreum*, n. sp.

Fig. 14. Animal, lateral view; magnified 6 diameters.

Fig. 15. *Scalpellum balanoides*, n. sp.

Fig. 15. Group of animals attached to an arm of a *Pentacrinus*; magnified 6 diameters.

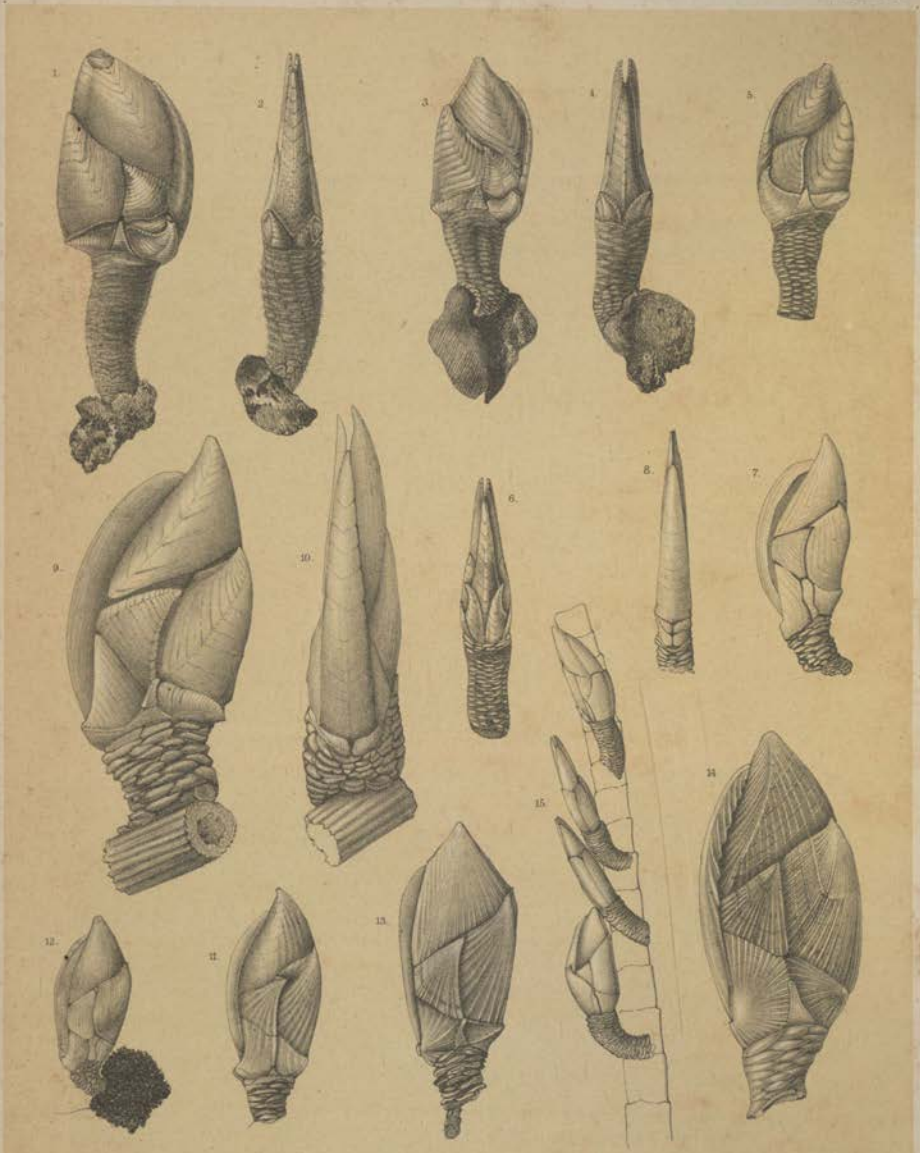


Fig. 7-10. 11-13. 14 F.H.G. Hoek Del. A.S. Brockelsen Del. A.J. Mandel Lithogr.

1-2 SCALPELLUM DARWINII. 3-4 SC. MOLUCCANUM. 5-6 SC. REGIUM var. ovalis. 7-8 SC. NOVAE-ZELANDIAE.
9-10 SC. TRITONIS. 11 SC. AUSTRALICUM. 12 SC. MINUTUM. 13 SC. TRUNCATUM. 14 SC. VITREUM. 15 SC. BALANOIDES.

PLATE VI.

PLATE VI.

Figs. 1, 2. *Scalpellum pedunculatum*, n. sp.

Fig. 1. Animal, lateral view; natural size.

Fig. 2. Animal, seen from the carinal side; natural size.

Figs. 3, 4. *Scalpellum insigne*, n. sp.

Fig 3. Animal, lateral view; magnified 2 diameters.

Fig. 4. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 5, 6. *Scalpellum marginatum*, n. sp.

Fig. 5. Animal, lateral view; magnified 2 diameters.

Fig. 6. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 7, 8. *Scalpellum ovatum*, n. sp.

Fig. 7. Animal, lateral view; natural size.

Fig. 8. Animal seen from the carinal side; natural size.

Fig. 9. *Scalpellum flavum*, n. sp.

Fig. 9. Animal, lateral view; magnified 6½ diameters.

Figs. 10, 11. *Scalpellum distinctum*, n. sp.

Fig. 10. Animal, lateral view; magnified 2 diameters.

Fig. 11. Animal, seen from the carinal side; magnified 2 diameters.

Fig. 12. *Scalpellum abyssicola*, n. sp.

Fig. 12. Animal, lateral view; magnified 6 diameters.

Fig. 13. *Scalpellum intermedium*, n. sp.

Fig. 13. Animal, lateral view; magnified 6½ diameters.

Fig. 14. *Scalpellum africanum*, n. sp.

Fig. 14. Animal, lateral view; magnified 6½ diameters.

Figs. 15, 16. *Scalpellum trispinosum*, n. sp.

Fig. 15. Animal, lateral view; magnified 2 diameters.

Fig. 16. Animal, seen from the carinal side; magnified 2 diameters.

Figs. 17, 18. *Verruca gibbosa*, n. sp.

Fig. 17. Animal, seen from the side of the movable scutum and tergum; magnified 6½ diameters.

Fig. 18. Animal, seen from the side of the immovable scutum and tergum; magnified 6½ diameters.

Figs. 19, 20. *Verruca sulcata*, n. sp.

Fig. 19. Animal, seen from the side of the movable scutum and tergum; magnified 6½ diameters.

Fig. 20. Animal, seen from the side of the immovable scutum and tergum; magnified 6½ diameters.

Figs. 21, 22. *Balanus corolliformis*, n. sp.

Fig. 21. Animal, lateral view; natural size.

Fig. 22. Animal, seen from above; natural size.

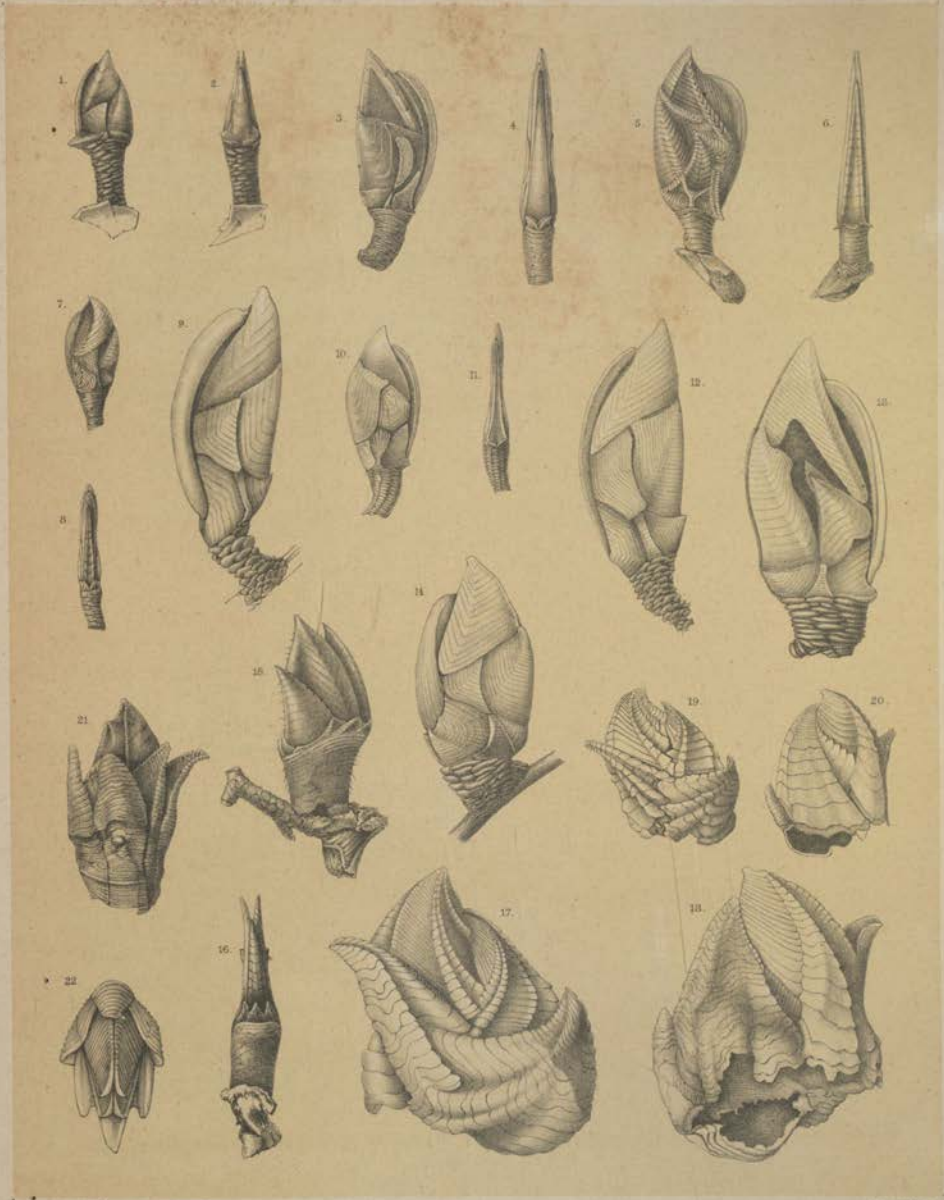


Fig. 9, 12-14, 17-20 F.P.C. Bosk. Cat. A.G. Bruchsler Del. A. J. Wendel Lithogr.

1-2 SCALPELLUM PEDUNCULATUM n. sp. 3-4 SC. INSIGNE n. sp. 5-6 SC. MARGINATUM n. sp. 7-8 SC. OVATUM n. sp. 9. SC. FLAVUM n. sp. 10-11 SC. DISTINCTUM n. sp. 12 SC. ABYSSICOLA n. sp. 13 SC. INTERMEDIUM n. sp. 14 SC. AFRICANUM n. sp. 15-16 SC. TRISPINOSUM n. sp. 17-18 VERRUCA GIBBOSA n. sp. 19-20 V. SULCATA n. sp. 21-22 BALANUS COROLLIFORMIS n. sp.

PLATE VII.

PLATE VII.

Fig. 1. *Scalpellum indicum*, n. sp.

Fig. 1. Animal, lateral view; magnified 6 diameters.

Figs. 2, 3. *Balanus lævis*, Brug.

Fig. 2. Group of animals; magnified 1½ diameters.
Fig. 3. One specimen, seen from the rostral side; magnified 2 diameters.

Figs. 4, 5. *Balanus amaryllis*, Darwin.

Fig. 4. Group of animals; magnified 1½ diameters.
Fig. 5. One specimen, seen from above; magnified 1½ diameters.

Figs. 6, 7. *Pœcilasma carinatum*, n. sp.

Fig. 6. Carina, interior view; magnified 4 diameters.
Fig. 7. Mandible of the left side; magnified 62 diameters.

Figs. 8, 9. *Megalasma striatum*, n. sp.

Fig. 8. Tergum, scutum, and carina, interior view; magnified 6 diameters.
Fig. 9. Maxilla; magnified 94 diameters.

Figs. 10, 11. *Alepas pedunculata*, n. sp.

Fig. 10. Labrum with the palpi (*pa.*); magnified 94 diameters.
Fig. 11. Second maxilla; magnified 94 diameters.

Figs. 12–14. *Scalpellum stroemii*, Sars.

Fig. 12. Mouth and first cirrus; magnified 41 diameters. *la.*, labrum; *md.*, mandible *sm.*, second maxilla; c^1, first cirrus.
Fig. 13. Mandible; magnified 94 diameters.
Fig. 14. Maxilla; magnified 94 diameters.

Fig. 1-5 A. H. Fischbacher Del. P. C. Hoek Del.

A. J. Wendel Lithogr.

1. SCALPELLUM INDICUM n. sp. 2-3 BALANUS LAEVIS Brug. 4-5 B. AMARYLLIS Darw. 6-7 POECILASMA CARINATA Hoek.
8-9 MEGALASMA STRIATA Hoek. 10-11 ALEPAS PEDUNCULATA Hoek. 12-14 SCALPELLUM STRÖMII Sars.

PLATE VIII.

PLATE VIII.

Figs. 1–5. *Scalpellum stroemii*, Sars.

Fig. 1. Larva in the Cypris-stage; magnified 94 diameters.

Fig. 2. Complemental male; magnified 94 diameters. *an.*, antennæ.

Fig. 3. Complemental male; magnified 94 diameters. *t.*, testis; *rs.*, receptaculum seminis; *o.*, genital aperture (?).

Fig. 4. Scutum, interior view to show the place where the complemental male is attached; magnified 8 diameters. *a.*, complemental male; *m.*, cavity for the adductor muscle.

Fig. 5. Second maxilla; magnified 94 diameters.

Figs. 6–8. *Scalpellum intermedium*, n. sp.

Fig. 6. Mandible; magnified 94 diameters.

Fig. 7. Maxilla; magnified 94 diameters.

Fig. 8. Complemental male; magnified 94 diameters.

Figs. 9, 10. *Scalpellum recurvirostrum*, n. sp.

Fig. 9. Maxilla; magnified 94 diameters.

Fig. 10. Caudal appendages; magnified 41 diameters. *ca.*, caudal appendages; *c.*, sixth cirrus; *p.*, penis.

Fig. 11. *Scalpellum compressum*, n. sp.

Fig. 11. Complemental male; magnified 41 diameters. *an.*, antennæ; *t.*, testis; *rs.* receptaculum seminis; *v.e.*, vas defernes; *o.*, genital aperture; *x.*, organ of unknown function.

Fig 12. *Scalpellum acutum*, n. sp.

Fig. 12. Mouth and first pair of cirri; magnified 41 diameters. *l.*, labrum; *pa.*, palpi; *sm.*, second maxilla; c^1, first cirrus; ♀ opening of the oviduct; *oe.*, œsophagus; *gs.*, ganglion supraœsophageale; g^1 and g^2, first and second thoracic ganglia; *x.*, so-called auditory sac.

1-5 SCALPELLUM STROMII Sars. 6-8 SC. INTERMEDIUM Hoek.
9-10 SC. RECURVIROSTRUM Hoek. 11 SC. COMPRESSUM Hoek. 12 SC. ACUTUM Hoek.

PLATE IX.

PLATE IX.

Figs. 1–5. *Scalpellum parallelogramma*, n. sp.

Fig. 1. Mandible; magnified 94 diameters.
Fig. 2. Maxilla; magnified 94 diameters.
Fig. 3. Second maxilla; magnified 41 diameters.
Fig. 4. First cirrus; magnified 6 diameters. *g.o.*, female genital pore.
Fig. 5. Female genital pore at the base of the first cirrus; magnified 41 diameters.

Fig. 6. *Scalpellum nymphocola*, n. sp.

Fig. 6. Part of the interior surface of the scutum, with the complemental male attached to it; magnified 94 diameters. *a.*, margin of the valve; *b.*, exterior; *c.*, interior layer of the mantle, between which two layers the male is attached; *d.*, musculus adductor scutorum.

Figs. 7–9. *Scalpellum velutinum*, n. sp.

Fig. 7. Male in the pupa-stage; magnified 41 diameters.
Fig. 8. Male in a somewhat older stage; magnified 94 diameters. *t.*, testis; *c. gl.*, glands at the base of the antennæ, probably cement glands.

N.B.—In this and in the following figures the male genital apparatus is coloured red.

Fig. 9. Male in a nearly ripe condition; magnified 41 diameters.

Figs. 10, 10*. *Scalpellum eximium*, n. sp.

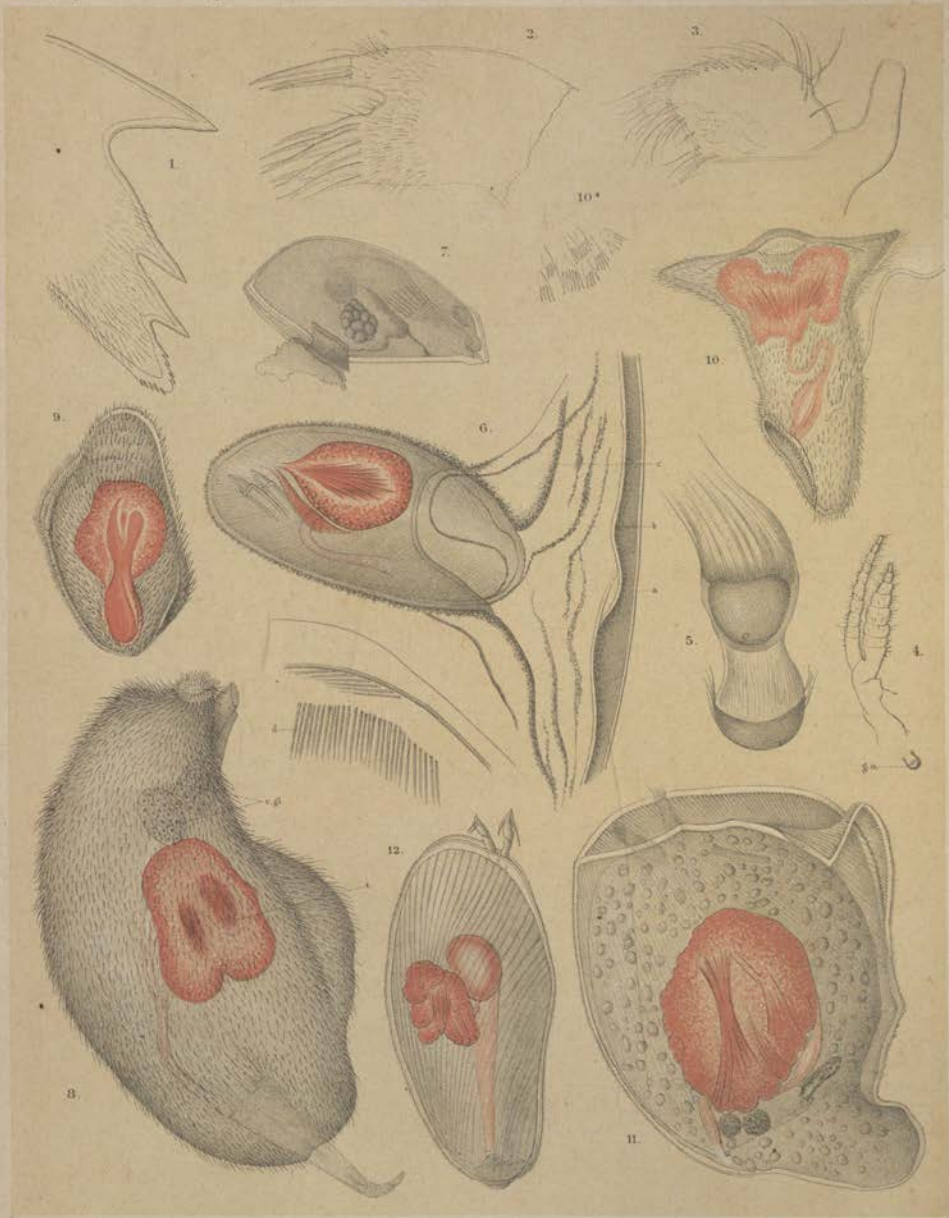
Fig. 10. Male; magnified 41 diameters.
Fig. 10*. Spines attached to the surface of the male; strongly magnified.

Fig. 11. *Scalpellum gigas*, n. sp.

Fig. 11. Complemental male; magnified 94 diameters.

Fig. 12. *Scalpellum regium* (Wyv. Thoms.), n. sp.

Fig. 12. Complemental male; magnified 41 diameters.



W. Hoek Del. A. J. Wendel Lithogr.

1-5 SCALPELLUM PARALLELOGRAMMA, Hoek. 6 SC. NYMPHOCOLA, Hoek. 7-9 SC. VELUTINUM, Hoek.
10 SC. EXIMIUM, Hoek. 11 SC. GIGAS, Hoek. 12 SC. REGIUM, (W. Th.) Hoek.

PLATE X.

PLATE X.

Figs. 1, 2. *Scalpellum regium* (Wyv. Thoms.), n. sp.

Fig. 1. Mouth and first pair of cirri; magnified 6 diameters.
Fig. 2. Edge of the maxilla; magnified 94 diameters.

Figs. 3–5. *Scalpellum darwinii*, n. sp.

Fig. 3. Complemental male; magnified 40 diameters.
Fig. 4. Genital apparatus of the male; magnified 94 diameters. *t.* testis; *r.s.*, receptaculum seminis; *v.e.*, vas deferens; *x.*, probably nervous system.
Fig. 5. Nervous system of the male strongly (275 diameters) magnified.

Fig. 6. *Scalpellum tenue*, n. sp.

Fig. 6. Complemental male; magnified 94 diameters.

Figs. 7–9. *Scalpellum flavum*, n. sp.

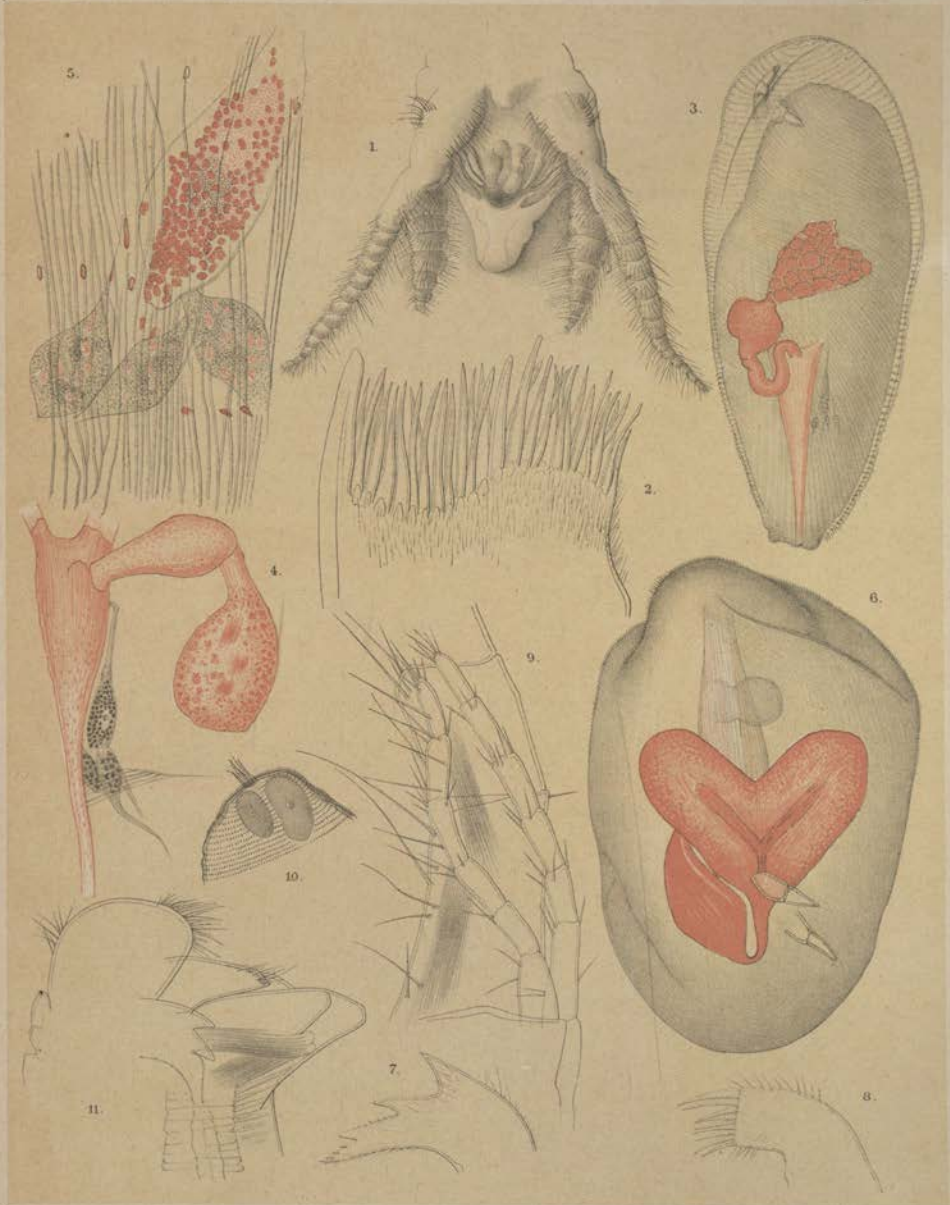
Fig. 7. Mandible; magnified 94 diameters.
Fig. 8. Maxilla; magnified 94 diameters.
Fig. 9. Caudal appendages; magnified 94 diameters.

Fig. 10. *Scalpellum tritonis*, n. sp.

Fig. 10. Rudimentary valves of the complemental male; magnified 94 diameters.

Fig. 11. *Scalpellum balanoides*, n. sp.

Fig. 11. Mouth; magnified 94 diameters.



1-2 SCALPELLUM REGIUM, (Wyv Thoms.) Hoek. 3-5 SC. DARWINII, Hoek. 6 SC. TENUE, Hoek.
7-9 SC. FLAVUM, Hoek. 10 SC. TRITONIS, Hoek. 11 SC. BALANOIDES, Hoek.

PLATE XI.

PLATE XI.

Figs. 1–3. *Scalpellum balanoides*, n. sp.

Fig. 1. Mandible; magnified 270 diameters.
Fig. 2. Maxilla and second maxilla; magnified 94 diameters.
Fig. 3. Caudal appendages; magnified 94 diameters.

Fig. 4. *Scalpellum triangulare*, n. sp.

Fig. 4. Maxilla; magnified 94 diameters.

Figs. 5–9. *Verruca gibbosa*, n. sp.

Fig. 5. Labrum, with palpi; magnified 94 diameters.
Fig. 6. and 6*. Left and right hand mandible; magnified 94 diameters.
Fig. 7. Maxilla; magnified 94 diameters.
Fig. 8. Second maxilla; magnified 94 diameters.
Fig. 9. Cirri, penis, and caudal appendages; magnified 39 diameters.

Figs. 10, 11. *Verruca quadrangularis*, n. sp.

Fig. 10. Mandible; magnified 270 diameters.
Fig. 11. Maxilla; magnified 270 diameters.

1-3 SCALPELLUM BALANOIDES, *n. sp.* 4 SC. TRIANGULARE, *n. sp.* 5-9 VERRUCA GIBBOSA, *n. sp.*
10-11 V. QUADRANGULARIS, *n. sp.*

PLATE XII.

PLATE XII.

Figs. 1–5. *Verruca gibbosa*, n. sp.

Fig. 1. Tergum, exterior view; magnified 7½ diameters.
Fig. 2. Scutum, exterior view; magnified 7½ diameters.
Fig. 3. Scutum and tergum attached to one another, interior view; magnified 5½ diameters.
Fig. 4. Scutum, interior view; magnified 7½ diameters.
Fig. 5. Tergum, interior view; magnified 7½ diameters.

Figs. 6–7. *Verruca nitida*, n. sp.

Fig. 6. Animal, seen from the side of the movable scutum and tergum; magnified 9 diameters.
Fig. 7. Animal, seen from the side of the immovable scutum and tergum; magnified 9 diameters.

Figs. 8–12. *Verruca quadrangularis*, n. sp.

Fig. 8. Animal, seen from the side of the movable scutum and tergum; magnified 7½ diameters.
Fig. 9. Animal, seen from the side of the immovable scutum and tergum; magnified 7½ diameters.
Fig. 10. Scutum and tergum, interior view; magnified 9 diameters.
Fig. 11. Tergum, exterior view; magnified 9 diameters.
Fig. 12. Scutum, exterior view; magnified 9 diameters.

Figs. 13, 14. *Verruca incerta*, n. sp.

Fig. 13. Animal, seen from the side of the movable scutum and tergum; magnified 9 diameters.
Fig. 14. Animal, seen from the side of the immovable scutum and tergum; magnified 9 diameters.

Figs. 15, 16. *Verruca obliqua*, n. sp.

Fig. 15. Animal, seen from the side of the movable scutum and tergum; magnified 7½ diameters.
Fig. 16. Animal, seen from the side of the immovable scutum and tergum; magnified 7½ diameters.

Fig. 17. *Verruca obliqua*, var.

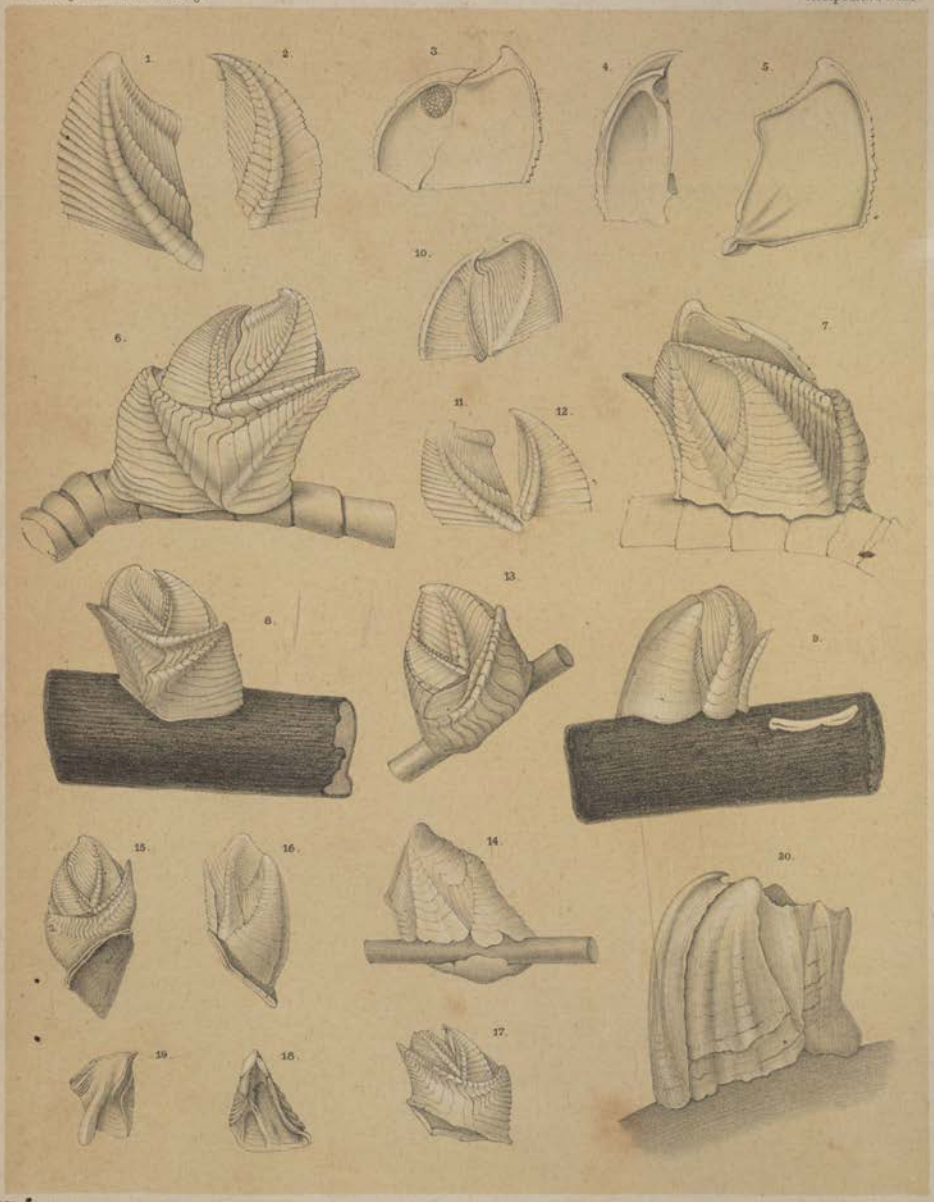
Fig. 17. Animal, seen from the side of the movable scutum and tergum; magnified 7½ diameters.

Figs. 18, 19. *Balanus tintinnabulum*, Linn., sp., var. *communis*, Darwin.

Fig. 18. Scutum, interior view; natural size.
Fig. 19. Tergum, interior view; natural size.

Fig. 20. *Balanus trigonus*, Darwin.

Fig. 20. Animal, lateral view; magnified 5 diameters.



P. C. Mask. Del. A.J. Wendel, Lithogr.

1-5 VERRUCA GIBBOSA, n. sp. 6-7 V. NITIDA, n. sp. 8-12 V. QUADRANGULARIS, n. sp. 13-14 V. INCERTA, n. sp. 15-16 V. OBLIQUA, n. sp.
17 V. OBLIQUA, var. 18-19 BALANUS TINTINNABULUM, var. communis. 20 B. TRIGONUS, Darwin.

PLATE XIII.

PLATE XIII.

Figs. 1–7. *Balanus corolliformis*, n. sp.

Fig. 1. Tergum, exterior view; magnified $1\frac{1}{4}$ diameters.
Fig. 2. Scutum, exterior view; magnified $1\frac{1}{4}$ diameters.
Fig. 3. Tergum, interior view; magnified $1\frac{1}{4}$ diameters.
Fig. 4. Scutum, interior view; magnified $1\frac{1}{4}$ diameters.
Fig. 5. Labrum; magnified 20 diameters.
Fig. 6. Mandible; magnified 20 diameters.
Fig. 7. Maxilla; magnified 20 diameters.

Figs. 8–15. *Balanus hirsutus*, n. sp.

Fig. 8. Group of specimens attached to a spine; magnified $1\frac{1}{2}$ diameters.
Fig. 9. Tergum, exterior view; magnified 5 diameters.
Fig. 10. Scutum, exterior view; magnified 5 diameters.
Fig. 11. Tergum, interior view; magnified 5 diameters.
Fig. 12. Scutum; interior view; magnified 5 diameters.
Fig. 13. Labrum; magnified 41 diameters.
Fig. 14. Mandible; magnified 41 diameters.
Fig. 15. Maxilla; magnified 41 diameters.

Figs. 16–22. *Balanus rostratus*, n. sp.

Fig. 16. Animal, lateral view; magnified $2\frac{1}{2}$ diameters.
Fig. 17. Animal, front view; magnified $2\frac{1}{2}$ diameters.
Fig. 18. Tergum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 19. Scutum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 20. Tergum, interior view; magnified $7\frac{1}{2}$ diameters.
Fig. 21. Scutum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 22. Maxilla; magnified 94 diameters.

Figs. 23–28. *Balanus socialis*, n. sp.

Fig. 23. Group of specimens; magnified $1\frac{1}{2}$ diameters.
Fig. 24. One of the specimens; magnified 4 diameters.
Fig. 25. Tergum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 26. Scutum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 27. Tergum, interior view; magnified $7\frac{1}{2}$ diameters.
Fig. 28. Scutum, interior view; magnified $7\frac{1}{2}$ diameters.

Figs. 29–33. *Balanus tenuis*, n. sp.

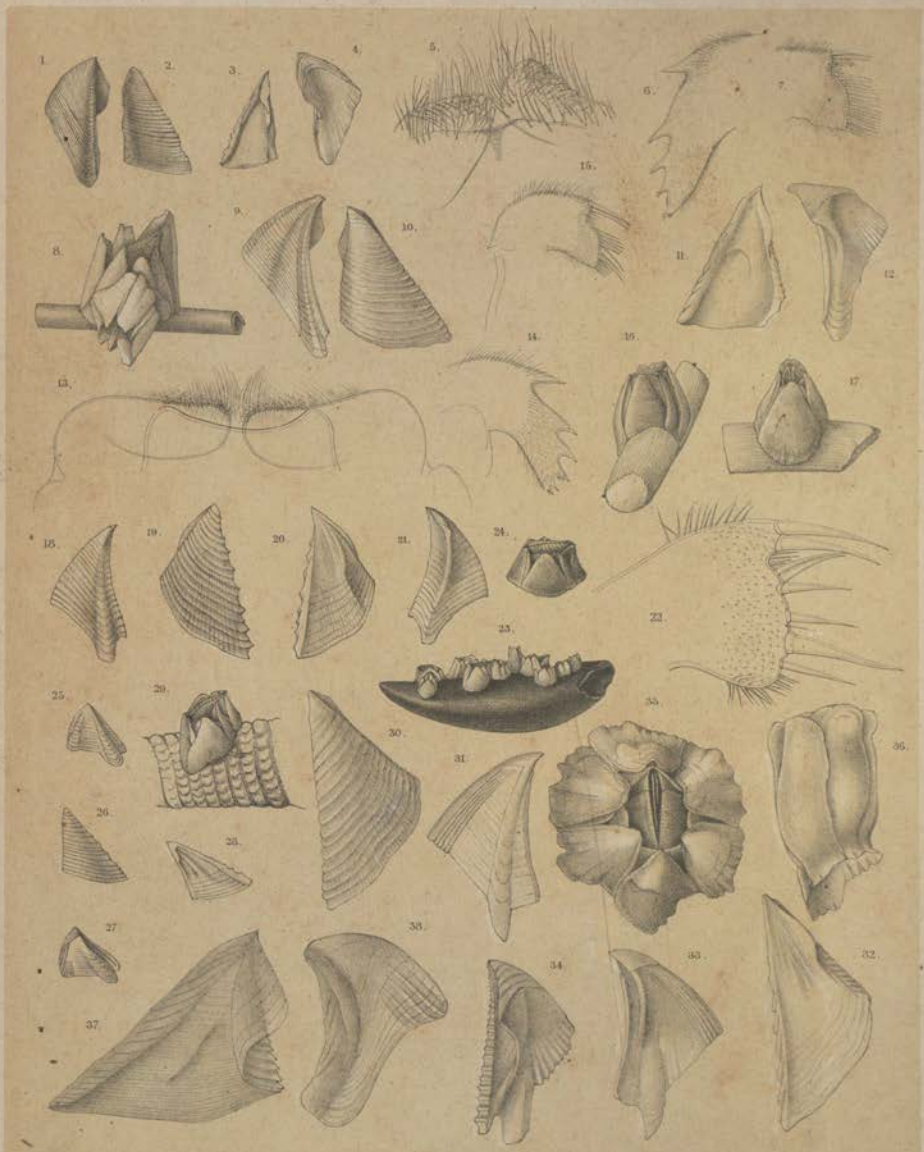
Fig. 29. Animal, lateral view; magnified $2\frac{1}{2}$ diameters.
Fig. 30. Scutum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 31. Tergum, exterior view; magnified $7\frac{1}{2}$ diameters.
Fig. 32. Scutum, interior view; magnified $7\frac{1}{2}$ diameters.
Fig. 33. Tergum, interior view; magnified $7\frac{1}{2}$ diameters.

Fig. 34. *Tetraclita coerulescens*, Spengler, sp.

Fig. 34. Tergum, interior view; magnified 4 diameters.

Figs. 35–38. *Chthamalus challengeri*, n. sp.

Fig. 35. Animal, front view; magnified $7\frac{1}{2}$ diameters.
Fig. 36. Animal, lateral view; magnified $7\frac{1}{2}$ diameters.
Fig. 37. Scutum, interior view; magnified 13 diameters.
Fig. 38. Tergum, interior view; magnified 13 diameters.



1-7. BALANUS COROLLIFORMIS, n. sp. 8-15. B. HIRSUTUS, n. sp. 16-22. B. ROSTRATUS, n. sp. 23-28. B. SOCIALIS, n. sp. 29-33. B. TENUIS, n. sp. 34. TETRACLITA CŒRULESCENS, Spengler, spec. 35-38. CHTHAMALUS CHALLENGERI, n. sp.

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on 02 July, 2018